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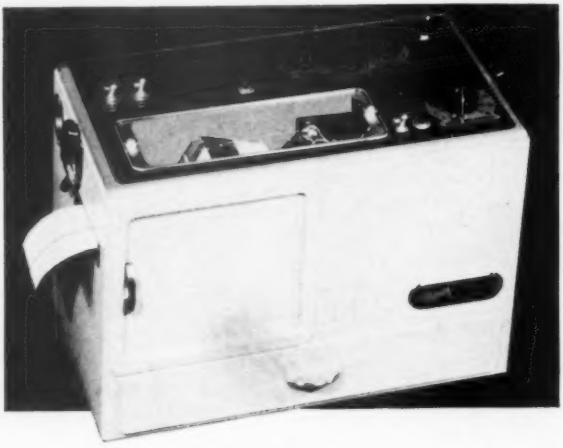

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Contents—Dec. 1951

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ORIGINAL ARTICLES

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EDITOR OF THE MONTH

WALTER M. SOLOMON, M.D.

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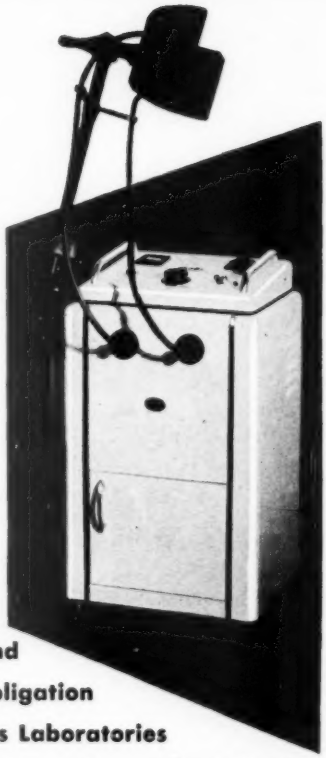

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RESEARCHES IN ELECTROMYOLOGY *

Preliminary Studies

H. WORLEY KENDELL, M.D.**
ARTHUR A. RODRIQUEZ, M.D.†
J. L. MURPHY, B.S.‡
and
H. W. PAVELA, B.S.§

CHICAGO

The use of electromyography as an important diagnostic and prognostic tool in departments of physical medicine and rehabilitation is rapidly gaining recognition by our medical colleagues. Physicians have been successfully employing characteristic variations in voltage, duration, and phase changes of muscle action potentials to denote, primarily, qualitative clinical correlation. Normal, fibrillatory, complex or nascent units and their wave variants are presently recognizable action potential wave forms.

The modern research process in clinical medicine usually begins with a theoretical consideration based on established data and, after experimentation, ends by being proved or disproved. In planning our researches in electromyography it was postulated that a study of wave forms might result in the recognition of other significant forms hitherto unrecognized by the present-day instrumentation and methods of analysis now employed. Accurate measurements are imperative. One of the major problems in the use of electromyography for diagnosis and prognosis of neuromuscular pathology has been to change the measurements from those now primarily qualitative to those of quantitative value. Thus, our research objective was formulated specifically to correlate the detailed properties of wave forms with neuromuscular pathology.

Like most problems, those of research in electromyography are complex enough to require, for successful solution, the combined efforts of a group. Therefore, early in this study, certain relevant resources of the Armour Research Foundation of the Illinois Institute of Technology were integrated with those of the Department of Physical Medicine and Rehabilitation of the University of Illinois, College of Medicine. The advantages gained from this kind of teamwork immediately became apparent to the physiatrists and engineers participating. Furthermore, the team agreed to the term "electromyology" *** as more descriptive of the broad scope of the research.

Electromyography Equipment

For the past two and one-half years we had been using commercially available electroencephalographic equipment modified for routine electromyography. The electrostatically shielded cage and the equipment for performing the tests are shown in fig. 1. The input signals originating from muscle action potentials are fed into an amplifier system, and from these, the

* Read at the Twenty-Eighth Annual Session of the American Congress of Physical Medicine, Boston, Mass., August 30, 1950.
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‡ Supervisor of Electronics, Armour Research Foundation, Illinois Institute of Technology.
§ Assistant Electrical Engineer, Armour Research Foundation, Illinois Institute of Technology.
*** The study of the electrical activity of muscle.
Note: Technical details have been deleted intentionally, but can be had on inquiry.

many times amplified signals go through the appropriate circuits to the recording instruments, namely, the pen recorders, cathode-ray oscilloscope, loudspeaker and voltage integrator. Four pen recording channels are available for simultaneous recordings from as many sets of pick-up electrodes. The cathode-ray oscilloscope and loudspeaker system are used for monitoring all pen and photographic moving film recordings. The first step was to subject our electromyographic equipment and methods of analysis to critical appraisal.

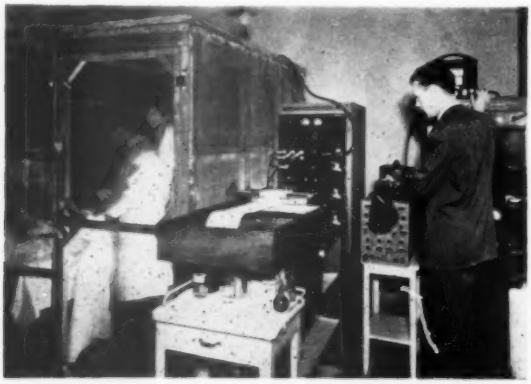

Fig. 1. — Electromyographic laboratory showing the electrostatically shielded cage with patient, physician and technician; the four-channel pen recorder, a rack holding the calibrator as well as four amplifiers; a cathode ray oscilloscope with high speed moving film camera mounted for use, and a second rack holding electronic integrator, power supply and loud speaker.

Instrumentation Analyses

No interpretation of records can be valid unless the characteristics and limitations of the recording equipment are fully known. Hence, the first problem was that of determining the response characteristics. The amplifiers were checked for frequency response both with and without the pen recorders, using a constant amplitude signal generator and a cathode-ray oscilloscope with a DC amplifier (fig. 2). The average frequency response for the 4 pens showed a dip in response in the vicinity of 50 cps. and a resonant frequency of the drive units at approximately 100 cps. The response was down to 10 per cent of its low frequency value at approximately 210 cps. (fig. 3). With a frequency response characteristic such as this, any irregular wave shape would be severely distorted. For this reason, pen recorders are of little or no value for recording potentials that are to be analyzed for their wave shape.

Analysis of Oscillograms

Having determined the characteristics of the electromyographic equipment employed for routine studies and then defined the electrical pattern of normal muscle action potentials, we directed our attention to establishing analytical methods that could be applied to analyses of oscillograms as recorded by a moving film camera.

In order to obtain permanent records for study at convenient times, a Fairchild Oscillograph Record Camera was used. With this type camera both continuous and single frame recordings can be made on standard 35 mm. roll film.

A periscope arrangement provides for mounting the camera on top of the oscilloscope without interfering with the operation of the controls. A viewing port in the optical system makes possible the simultaneous viewing and recording of the oscillograph screen.

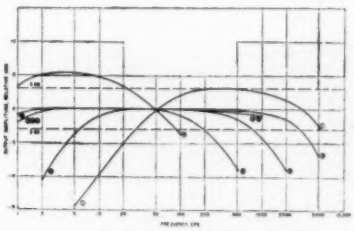

Fig. 2. — Frequency Response.

Ampere Setting.	Frequency	
	Low	High
(1)	.002	0
(2)	.02	0
(3)	.2	0
(4)	.5	0
(5)	.2	1
(6)	.2	2
(7)	.2	3

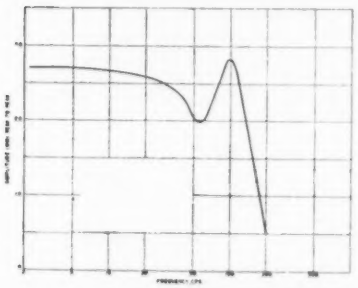

Fig. 3. — Crystograph pen drive record showing average frequency response of the four pens.

The method of moving film was used for recording electromyographic data. This method utilizes the motion of the film as a time base and records along the length of the film. The electromyographic data to be recorded were connected to the oscilloscope to produce deflection at right angles to the motion of the film. The speed of this particular camera was variable over a 60 to 1 ratio. The particular records studied were recorded at a speed of 24 inches per second. Frequencies up to approximately 10,000 cycles per second can be handled with the film speeds available with this unit.

A neon timing light in the camera was used to record timing-marker spots along the film as a check on film speed and a means of time measurements of the recorded signals.

Approximately 100 moving film records of muscle action potentials from normal and pathological muscles were taken at a camera speed of 2 feet per second. (See figs. 4 and 5 for representative oscillograms.) The pathological material was selected from a poliomyelitis patient with muscle grades of 3*

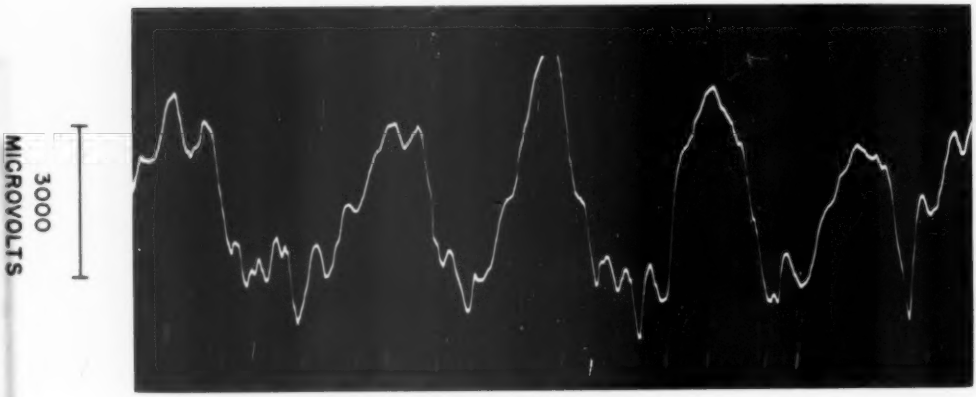

Fig. 4. — Oscillogram from normal left biceps recorded at a film speed of two feet per second, and representing 0.09 seconds during active voluntary muscle contraction against maximal resistance throughout range of motion. Inability to make out discrete motor unit discharges is characteristic of the "interference" pattern found in normal muscles contracting forcefully.

or less. Various methods of analysis were also considered, for example, Fourier analysis, duration of pulse, integration and peak distribution. Although it was believed they could be applied to such studies, such application would be impractical for routine diagnosis analysis. The peak distribution analysis, in our opinion, offered the best compromise for this preliminary survey.

Peak Distribution Analyses

Technique for Analyzing Oscillograms. — The film record was projected on a ground glass screen with equally-spaced grid lines, and the positive and negative peaks were counted according to the grid divisions within which they occurred and recorded on a tally sheet. The number of peaks falling

* A voluntary muscle test is recorded as grade 3 if it completes the available range of motion against gravity with no resistance, two or three times.

in any given amplitude range were then plotted as a percentage of the total number of peaks counted.

Hypothesis for Peak Amplitude Distribution Study. — It is reasoned that the number of peaks seen in any given electromyographic recording should be proportional in large measure to the number of electrical discharges, which can influence the recording electrodes.[1] The number of peaks above an amplitude of 100 microvolts will be reduced in the electromyogram recorded

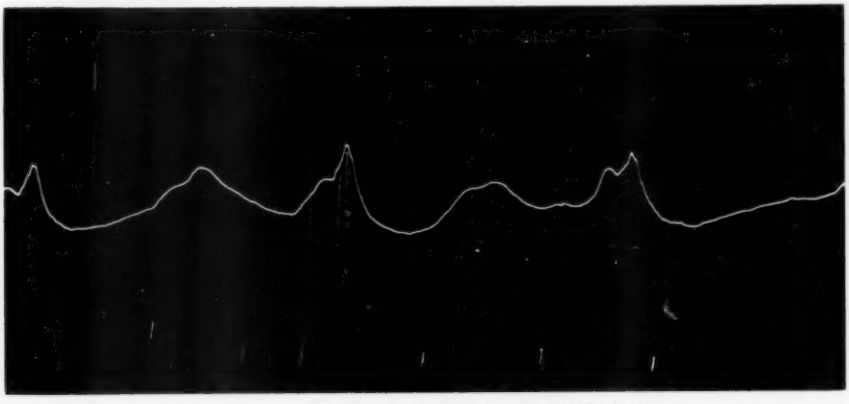

Fig. 5. — Oscillogram from pathological left biceps of poliomyelitis patient recorded at a film speed of two feet per second and representing 0.09 seconds during active voluntary muscle contraction against maximal resistance throughout range of motion. Four motor units, all of low amplitude and at a distance from the electrode are discharging regularly.

from a patient whose neuromuscular disease is characterized by a loss or reduction of motor units.[2] Furthermore, the amplitudes at which these peaks will be distributed will depend upon the total voltages of the units and the manner in which they discharge. For example, normally motor units discharge in an asynchronous fashion.[3] Sometimes the discharge of one unit superimposes itself upon the discharge of another, while at other times it is completely non-synchronous. This seemingly "helter-skelter" mechanism has such a degree of consistency that it has become common parlance among electromyographists to speak of this as "the normal interference pattern."[4]

1. Brown, D. D.: Interpretation of the Electromyogram, Arch. Neurol. & Psychiat. **61**:99 (Feb.) 1949.
2. Buchthall, Fritz, and Hencke, Paul: Electromyographic Examination of Patients Suffering from Anterior Acute Poliomyelitis Up to Six Months After the Acute Stage of Disease, Acta Med. Scand. **116**: 148, 1944.
3. Forbes, Alexander, and Barbeau, Antonio: The Question of Localizing Action Currents in Muscle by Needle Electrode, Am. J. Physiol. **80**:705, 1927.
4. Hirschberg, G. G., and Abramson, A. A.: Clinical Electromyography, Arch. Phys. Med. **31**:676, 1950.

If these peaks are counted and their distribution within certain amplitude ranges noted, it may be postulated that statistically constant values for each neuromuscular entity may exhibit a pattern that can be identified providing the identical electrode and testing technique is used each time.

Electromyographic changes in diseases of the neuromuscular system frequently manifest themselves by either a loss of motor units (as in anterior horn cell disease), a loss of total electrical voltages (as in myogenic atrophies), or a combination of the two. The number of active motor units and the total electrical voltages obtained are the two factors involved in this analysis, therefor these changes should be reflected in the peak ampltiude curves.

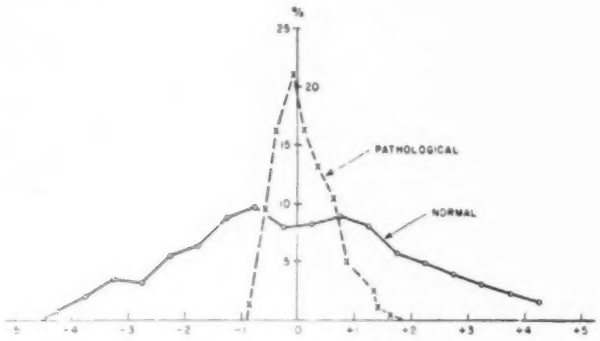

Fig. 6. — Comparison of peak amplitude distribution curves derived from normal and pathological biceps muscles during isotonic contractions against maximum load.

Accepting this hypothesis, we proceded with the analytical studies and results are being reported only from a statistical basis. It should be emphasized that these preliminary studies are of a statistical nature, not primarily physiological. In other words, this is a statistical analysis of physiologic phenomena.

Results of Studies

Isotonic Muscle Contractions. — The action potential wave patterns from a representative normal biceps were compared with the action potential wave patterns of a grade 2+ biceps muscle of a poliomyelitis patient. We chose at random 2 to 4 one-foot oscillogram sections corresponding to 0.5 second intervals from each record to achieve adequate statistical sampling and averaged the results.

The results of the peak distribution analyses for normal muscle action potential wave patterns were compared with the peak distribution analyses for muscle action potentials from a poliomyelitis paretic muscle, grade 2+ (fig. 6). In the normal the peak distribution curve showed two slight maxi-

mum peaks, one on each side of the base line. In the graph, this double-peaking was absent from the pathological muscle. Furthermore, a greater percentage of peaks of low magnitude was noted in the paretic muscle as compared to those recorded from normal muscles. In both the normal and pathological the muscle action potentials were recorded while the patient was performing active voluntary muscle contractions against maximal resistance throughout the range of motion.

Isometric Muscle Contractions. — Repetitive recordings were made on the same patients, performing maximal isometric muscle contractions. In order to assure maximal effort by the patient, a hand spring dynamometer was

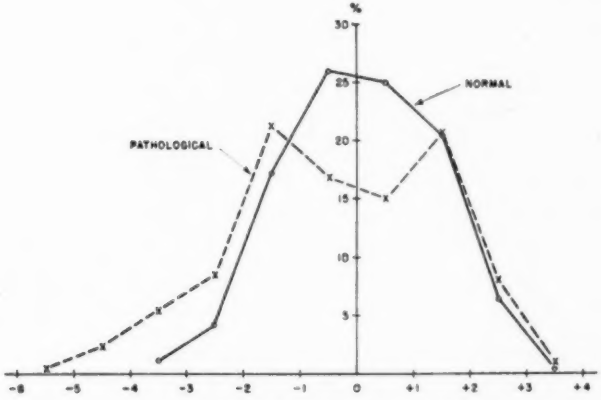

Fig. 7. — Comparison of peak amplitude distribution curves derived from normal and pathological biceps muscles during isometric contractions against maximum load.

applied just above the wrist joint. The patient held his elbow at 30 degrees flexion, as the tension of the dynamometer was increased, until maximum was obtained. It was observed that the action potential waves from the paretic poliomyelitis muscle showed a double peak curve and skewness to the left (fig. 7).

The number of records analyzed to date, although too small in number for statistical evaluation, nevertheless, suggests that the peak distribution analyses of numerous records from similar cases should determine a similarity in shape of the frequency distribution curve. It is, therefore, possible that standard numerical statistical measures can be applied to these computations. It is well recognized that a large number of records must be obtained and analyzed to provide sufficient data for adequate correlation with clinical findings.

This type of analysis seems to yield reproducible results but it is obviously laborious, time-consuming, and uneconomical. Furthermore, it is open

to subjective error in counting and identifying the peaks. While it is possible that automatic counting from film records could be performed, it would require complex optical screening methods and associated electronics, which make this method impractical.

Recording Medium

After consideration of the problems attending the known methods of analysis, it became apparent that many of these problems were inherent in the nature of the recording medium. A more practical approach, therefore, would be to seek a recording medium which by its nature would permit the use of more practical automatic methods of analysis.

The electrical requirements for a suitable recorder having been established, other factors of a non-technical nature such as economy in structure, size, and operation were considered in the selection of the most suitable recording medium. In addition, the moving film oscillographic recorder, which was used in these studies, magnetic oscillographs, single sweep cathode-ray oscilloscopes, and magnetic recorders were considered. With the exception of the last mentioned, all have a primary disadvantage in that photographic processing is necessary before the recording can be used for analysis. Further, the cost of supplies for these media markedly increases the cost, since film speeds in the order of 2 feet per second are necessary to resolve the important frequencies.

With the foregoing facts considered, it was decided to investigate the possibility of developing the magnetic recorder, which requires no processing of film and offers the possibility of re-recording as desired. Also, playback output voltage may be fed into various electronic analyzing devices, eliminating a complex film reader that would be required with photographic media.

In view of the advantages offered by magnetic recording, laboratory equipment was set up to determine the special circuit requirements of this medium for the type of wave forms found in muscle action potentials. Since most of the knowledge of magnetic recording processes is limited to audio applications or instrumentation use with relatively elaborate modulation systems, information was not available on equalization circuits suitable for direct recording of random signals such as those produced by contraction of muscle tissue. In sound recording, the relative phase of the different frequencies present is of no importance, as the human ear apparently is not sensitive to this property of the sound waves, but phase is of great importance in the accurate reproduction of wave forms such as are produced by muscle action potentials. The usual equalization for sound recording theoretically does not satisfy the phase requirements for the present application; but it was found in practice that fairly good results could be obtained with circuits similar to those used in sound work, but with more careful attention to extension of the low frequency response.

With constant-current recording in conformance with standard sound practice, the signal from the playback head of the recorder has the phase corresponding to differentiation of the input voltage (a shift of 90 degrees leading), and an amplitude characteristic closely resembling the first half-cycle of a sine wave over the frequency range of interest. Therefore, in order to reproduce the initially recorded signal perfectly, the playback signal should be both integrated and modified by selective networks to compensate for the sine shape of the amplitude response. In practice, an integrating am-

plifier which will produce the corrective 90 degrees phase lag required, will also have an amplitude drop of 6 decibels per octave which will approximately compensate for the sine wave amplitude shape up to its maximum. Above this point, perfect equalization requires the use of an "all-pass" network, since all the ordinary "minimum phase" type of networks have a fixed phase characteristic associated with any given amplitude characteristic and the two are incompatible above the maximum. For the initial studies in recording muscle action potentials simple equalization was adequate using a maximum recording speed of 7½ inches per second which gives an amplitude maximum at 3,000 cycles per second.

The amplifier was designed to cut off at approximately 4,000 cps. The rise time of the whole process is approximately 0.1 milliseconds, which was found to be necessary for adequate reproduction of muscle action potentials.

As a result of the studies to date, a magnetic recorder was developed which conforms to the following tentative specifications:

1. Frequency range 50 to 4,000 cps.
2. Phase shift within ±5 degrees over the above frequency range.
3. Full-scale input voltages from 100 to 6,000 microvolts peak to peak.

Summary

To date no detailed analytical studies of wave form or correlations with neuromuscular pathology as recorded by the magnetic recorder have been completed.

This medium offers many potentialities for recording muscle action potentials. In our opinion, the major advantages as compared with other methods of recording commonly employed today are:

1. Analysis of recording may be made at the convenience of the physiatrist.
2. Recordings may be made by a trained technician.
3. Photographic recordings may be made after analysis.
4. There is a permanent record for teaching and research.
5. Laboratory analysis of wave properties may be made in remote analytical centers.
6. Magnetic tape is accessible and economical for permanent records.
7. The tape may be easily edited and re-recorded.

Discussion

Dr. Arthur A. Rodriquez (Chicago): Action current of muscle was studied as long ago as 1840 by Matteuci, and yet it has only been in recent years that the science of electromyography has shown any signs of achieving recognition. This development has been contingent upon two important factors: first, the introduction of electronic devices which met at least the minimum requirements of fidelity, and, second, the understanding of basic physiologic principles underlying the neuromuscular apparatus in health and disease. A good start has been made, but the road is still wide open and there are many frontiers to conquer.

The authors are to be congratulated both for their specific contributions and for their healthy pioneer spirit.

Dr. Kendell has repeatedly reminded us of the tremendous advantages of cooperative research. This principle bears repetition. Whether we like it or not, we live in an age of specialization: A good physician can hardly also be a good electronic engineer. I could think of no better man for the electromyographer to have on his team.

The development of the electromagnetic tape recorder for the recording of muscle potentials was the result of just such team work both in London and in Chicago. At

both places the need was seen for this type of recording device and, interestingly, parallel paths were followed to develop it.

Regarding Dr. Richardson's tape recording unit, I know that he agrees that a tape speed of 1 m. a second is unnecessary and that the speed of 7½ in. a second is adequate to satisfy the upper frequency requirements. I should like to ask: "What is a Tonies compressor? And would you care to comment about the desirability of extending the frequency response to lower values?

Dr. Richardson is not alone in his difficulty in demonstrating fibrillation potentials. This difficulty has been encountered in our clinic, as well as by many others. The muscle is warmed and, if fibrillation not obtained, neostigmine is given. Neostigmine allows the acyetylcholine to achieve its action on the sensitized denervated muscle at the neuromuscular junction and thereby helps to bring out the fibrillatory response. I definitely agree that the electrical test should precede and be correlated with each electromyographic study. I should like to ask Dr. Richardson another question about his search for spontaneous units in nerve pressure lesions: How many portions of the muscle were sampled and at how many depths? This is particularly important when the coaxial needle electrode is used, since its area of pick-up is very small.

Dr. Knowlton's and Dr. Bennett's study showed that some poliomyelitic muscles reveal decreasing rather than increasing voltages as the muscle works to fatigue. This is an interesting contribution to our knowledge of poliomyelitis and immediately raises a number of questions about the mechanism at work here. I hope they will pursue their study and bring us a progress report about the correlation of this finding with clinical experience as suggested. It would be a great contribution to the management of poliomyelitis, and possibly other related neuromuscular disorders, if a test procedure could help guide us in our therapeutic exercise programs.

Dr. Bierman has given an excellent review of some of the extensive applications of electromyography and has pointed the way to possibly even wider uses. Because of the limitation of time I shall leave specific comments on his and the remaining papers to Dr. Ehrlich.

I should like to say that the authors have performed a real service. I hope that their work will stimulate others to do research, to do it cooperatively when so indicated, and to cooperate with whoever can best help in achieving the desired goal. Electromyography will never become a substitute for good clinical judgment, but it appears to be well on its way to becoming a very valuable adjunct.

Dr. Joshua Ehrlich (Louisville): During the last decade we have been witnessing a new trend in neuromuscular research, mainly electromyographic studies. Perhaps we should say a revival, to a great degree, of the original attempts made in this field during the late twenties, at which time I had the privilege of working with Dr. Besse, one of the pioneers in electromyography, in Geneva, Switzerland. The results of our work (I have to admit poor, in comparison with the present knowledge) were discussed at the International Meeting of Physical Therapy and Radiology in Paris, in 1930. We called this procedure at that time "electromyometry." I am mentioning this because I feel it is appropriate to pay tribute, at this time, to the memory of Dr. Besse.

When we compare the different means of testing in the neuromuscular field, we realize that each new procedure used in the field of electrical testing is better than the preceding. During the first World War we used the faradic and galvanic currents, then chronaxie and others.

Today we heard six papers on electromyography. Dr. Rodriquez discussed three of these, so I will discuss the other three, and will touch briefly on the three discussed by him.

Dr. Abramson's and Dr. Hirshberg's paper should be of special interest because the authors discussed a special group of cases, spastic paralysis. Some of their observations I should like to emphasize: (1) the occurrence of unilateral spasticity under certain circumstances suggesting a central barrier in the cord which prevents the spread of spasticity to the opposite side; (2) the phenomenon, which the authors call perpetuation, which is the motor response outlasting the stimulus in severe spasticity (when perpetuation occurred, the relationship between stimulus and motor activity was lost); the decrease in spasticity of some groups of muscles in cases in which tenotomy, amputation, or denervating the muscle group was performed.

Dr. Bierman in his paper emphasized the value of electromyography in reference to the treatment prescribed. On the basis of the more detailed information concerning muscle action, the proper prescribed exercises, such as utilization of occupational therapy, would be easier determined. He discussed his personal observations and also the observations of other investigators concerning the influence of heat and cold on action potentials; as an example, fibrillation can be easier elicited after previous application of heat to the involved region. He also discussed electromyography in measuring muscle power and its value in considering the prescribed treatment, and the beneficial influence of massage and passive exercise revealed by electromyography (lower incidence of observed fibrillation). Dr. Bierman's paper gives an excellent review of the bibliography on electromyography.

Dr. Huddleston and Dr. Golseth gave a very detailed analysis of different neuromuscular disorders involving the lower and upper motor neurons. They came to the conclusion that electromyography has full value in conjunction with other clinical

findings (symptoms, signs, laboratory tests). Their observations on the value of the electromyograph in differential diagnosis is very interesting.

Dr. Richardson (closing): Dr. Rodriquez has asked a series of questions about the technical characteristics of the electromyograph designed and built at St. Thomas' Hospital. For a complete answer to his questions I must refer him to the paper by Bauwens and Styles read before the Institute of Electrical Engineers in London. Briefly, however, a Tonnies compressor is a stage used in amplifiers which converts the push-pull input to a single ended output. With regard to frequency response that should be used in electromyography, it is necessary to relate this to the type of work being undertaken. Thus in clinical electromyography, in which the relationship of the detected muscle action potentials to the site of the lesion is studied empirically, a limited frequency response is permissible. If, however, it is desired to analyze muscle potential wave forms accurately then a frequency response greater than that generally used in clinical work is necessary, in fact, a D. C. amplifier is more appropriate. Although the time constant of our magnetic tape recording equipment is 5 milliseconds, we have little difficulty in allowing for amplifier overshoot when measuring durations and our high frequency response avoids excessive integration of polyphasic potentials.

In searching for electromyographic signs in nerve compression lesions, several explorations with a coaxial needle electrode are made and, in most cases, examination with surface electrodes carried out first. I should perhaps emphasize that although all our patients had clinical signs of disturbed nerve conduction, this was in all cases normal to electromyographic examination localized to the sensory component. It is not unusual for patients with nerve compression to appear normal on clinical examination but to show fibrillation activity on electromyographic examination.

INFLUENCE OF ALTERNATE AND RECIPROCAL EXERCISE ON WORK CAPACITY *

F. A. HELLEBRANDT
SARA JANE HOUTZ
and
ROBERT N. EUBANK

RICHMOND, VIRGINIA

Injury or disease of the neuromuscular system affects work capacity in a variety of ways. Inflammation, fibrositis or pain may restrict range of motion, resulting in disuse atrophy of the muscles activating the involved joints. Pseudoparesis is often a complicating factor in rehabilitation management. This is characterized by inability to call forth maximal contraction even though there is no disease in the central or peripheral nervous system. The inhibition may be reflex and secondary to pain, or it may be psychogenic in origin. Thus disease or trauma may reverberate in ways leading to chronic invalidism prolonged beyond the limits of healing.

Restoration of the functional capacity of the neuromuscular system is dependent upon restitution of a number of interrelated variables. Chief among these are coordination and rhythm of movement, mobility, strength, endurance, reaction time, and speed of motion. Once the first three have been attained, the others usually follow autonomously or are readily subject to improvement. Augmentation in strength is probably primary. Increased range of motion often occurs *pari passu* with gain in power. If the rate of working per unit of time is controlled, improvement in coordination and endurance also follow automatically.

It has been insufficiently appreciated that development of strength demands training in the over-load zone. The stress imposed must exceed that which can be met easily by the subject. Thus, success in treatment is related to the resolution of a troublesome dilemma. How to elicit an all-out effort in the face of psychogenic or nociceptive inhibition? A variety of dynamogenic devices may be utilized. These are classifiable into two major categories, physiologic and psychologic, which can be separated only with difficulty. Both are important and both demand attention in the planning of a treatment program.

Work done previously in this laboratory demonstrated the probable value of cross education as a therapeutic device[1] and indicated that the concurrent exercise of homologous parts might be utilized to augment the functional capacity of the weaker side.[2] The purpose of this study was to evaluate the influence of alternate and reciprocal exercise on work output.

Methods

The subjects of this investigation were 49 normal healthy adults, ranging in age from 19 to 44 with a mean age of 27.82 years. The average height and weight of the 25 male subjects was 5 ft. 8 in. and 167.14 lbs., respectively.

* Read at the Twenty-Eighth Annual Session of the American Congress of Physical Medicine, Boston, Mass., September 1, 1950.
* From the Division of Clinical Research, Baruch Center of Physical Medicine and Rehabilitation, Medical College of Virginia.
1. Hellebrandt, F. A.; Parrish, A. M., and Houtz, S. J.: Cross Education: The Influence of Unilateral Exercise on the Contralateral Limb, Arch. Phys. Med. 28:76 (Feb.) 1947.
2. Hellebrandt, F. A., and Houtz, S. J.: Influence of Bimanual Exercise on Unilateral Work Capacity, J. Appl. Physiol. 2:446 (Feb.) 1950.

The 24 females had a mean height of 5 ft. 4 in. and a mean weight of 125.14 lbs. Of the total group, 93 per cent had majored in physical education or were active participants in sports. Competition was keen. Daily work graphs were posted and every opportunity was taken to elicit an all-out effort on the part of the subjects.

In toto 275 experiments were performed. The results obtained from two experiments on one subject were excluded because they followed too closely upon a recent illness; all experiments performed by another subject were excluded because of a chronic disabling physical handicap involving the extremity subjected to exercise. Forty-nine additional experiments on bilateral exercise, not included in this analysis, formed a part of the standard procedure. Thirty-five miscellaneous experiments performed on 10 subjects illustrate the main points of the study by several different techniques of applying the exercise.

All experiments were performed on the wrist ergograph, of which two identical pieces of equipment were available. This device has been described elsewhere.[3] The exercise selected was wrist extension. The experiment was designed to minimize and exclude training effects and give maximal advantage to the non-preferred or weaker extremity. The experiments, which lasted from 15 to 30 minutes and required an average of 7 to 9 bouts of 25 repetitive contractions, were scheduled at weekly intervals at approximately the same time of day for any given subject. This is far below optimum for training.[4] Right and left sided unilateral exercise was used as a control. To exclude the effect of training from the analysis of the influence of different types of exercise, the activities prescribed were scheduled in random order. These included alternate bouts, performed first with the preferred and then the non-preferred hand, bilateral exercise, reciprocal exercise and alternate strokes. To observe the effects of training *per se*, the unilateral control was repeated at the end of the series by 63 per cent of the subjects. Because the alternate stroke experiments introduce a variable not present in the other procedures (*a rest pause between each contractile effort, equal in duration to the time required to lift and lower the load*), a control run was performed by each subject to evaluate this factor. The rhythm of contraction was held constant. Every two-count stroke was followed by a two-count rest pause.

The subjects were seated comfortably on an adjustable stool placed between two ergographs. Wrist extension was performed with the forearm in pronation as a two-count exercise to the rhythm of an audio-visual metronome. This was held constant for all subjects and all experiments. The exercise consisted of twenty-five repetitive maximal contractions per bout. The load was lifted and lowered as nearly as possible at the same rate. There was no rest pause at the height of the shortening contraction or the termination of the lengthening contraction. Preliminary experiments demonstrated that when the metronome was set at 100 the rhythm of contraction was optimal for the exercise under study. A uniform rest pause of thirty seconds was permitted between successive bouts. The limit day procedure was used throughout the series. Commencing with 0.5 kg., the load was increased by increments of 0.25 kg. in each successive bout until the weaker hand failed to perform the requisite number of strokes per bout in the prescribed rhythm. Only in the control series was the preferred hand allowed to continue until it also failed. Because the alternate stroke series introduced a rest pause after each individual contraction, the load increments were doubled in an

3. Hellebrandt, F. A.; Skowlund, H. V., and Kelso, L. E. A.: New Devices for Disability Evaluation: 1. Hand, Wrist, Radioulnar, Elbow and Shoulder Ergographs, Arch. Phys. Med. 29:21 (Jan.) 1948.
4. Hellebrandt, F. A., and Skowlund, H. V.: The Application of Ergography to Disability Evaluation: 1. The Normal Fatigue Curve, Am. J. O. T. 1:73 (April) 1947.

effort to make all experiments as comparable as possible. It has been postulated that if the load is doubled and the rest pause tripled, the work done remains approximately constant.[5] Our subjects therefore worked under somewhat of a handicap during this series, and any augmentation in work output should have significance in spite of the variation in procedure if the hypothesis discussed by Maggiora is valid. The forearm was so fixed that no movement other than extension at the wrist joint was recorded. No effort was made to suppress spontaneous movements of parts of the body not directly

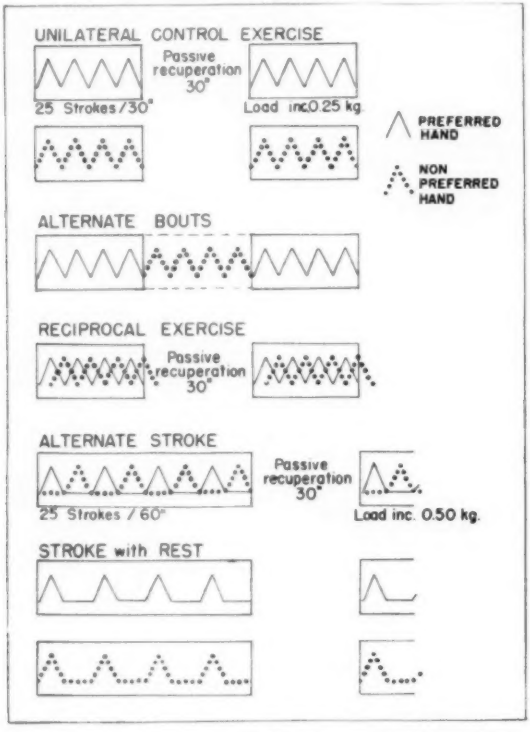

Fig. 1. — Schematic diagram illustrating the way in which the method of performing a standard exercise was varied. The upstroke represents the lifting of the load or the shortening contraction of the wrist joint extensors; the downstroke, the lowering of the load by a lengthening contraction of the wrist joint extensors.

involved in the performance of the prescribed exercise. However, these were carefully observed and noted.

Two observers were always available for the performance of these experiments. They recorded the initial and final readings of the meters which cumulated the distance through which the load had been raised and lowered per bout. During alternate bouts the preferred hand contracted twenty-five times and without losing a count this was followed by twenty-five contractions of the non-preferred hand (fig. 1). Thus one hand was always resting

5. Maggiora, A.: Les lois de la fatigue étudiées dans les muscles de l'homme, Arch. Ital. de Biologie 13:157, 1890.

while the contralateral limb exercised. Meticulous attention was given to the differentiation between alternate stroke and reciprocal exercise. In the latter, one extremity was performing a shortening contraction of the wrist joint extensors while the opposite extremity was performing a lengthening contraction of the same muscle groups. Both arms rested simultaneously between bouts when performing alternate stroke and reciprocal exercise. Kymograms were made of all ergographic work done. By noting the extent and rhythm of successive strokes on the kymogram, the skilled observer could evaluate the character of the subject's response and make such admonitions as indicated to insure an all-out effort. The amount of guidance and encouragement required varied with the subject. This demands considerable judgment on the part of the individual administering the exercise. It is impossible to evaluate the efficacy of different types of volitional effort without being reasonably certain that every contraction made is maximal. Only the highly trained and experienced laboratory subject can achieve this without psychological assistance. If the untrained subject is permitted to determine his own end-point of effort, this invariably falls far short of the physiological maximum. The importance of this psychogenic factor is well recognized in clinical work with the disabled.

Results and Their Interpretation

The experimental findings are summarized in table 1. The reliability of the differences between the means was computed, comparing all types of exercise with the first control. The interpretation of differences is summarized in table 2. Since experiments on human subjects performing volitional physical activity are influenced by numerous uncontrollable factors, the 0.05 level of significance is sufficiently exacting for the purposes of this

TABLE 1. — *The Influence on Ergographic Work Capacity of Variations in the Method of Performing Identical Exercise.*

Method of Exercise	No. Cases	Mean Total Work Kg.m.	Sigma	V
Unitlat. Control 1	47	137.19	69.62	50.75
Alternate Bouts	48	183.06	81.46	44.50
Reciprocal Ex.	48	172.58	80.54	46.67
Alternate Strokes	48	198.85	99.04	49.81
Stroke with Rest	48	195.58	102.28	52.30
Unilat. Control 2	28	186.32	88.44	47.47

TABLE 2. — *Comparison of the Total Work Done by the Right and Left Hands During Various Methods of Performing Identical Exercise with Unilateral Control Observations.*

Method of Exercise	"t"	P
Unilat. Control 1 with Unilat. Control 2	2.47	.02
Unilat. Control 1 with Alternate Bouts	2.92	.01
Unilat. Control 1 with Reciprocal Exercise	2.27	.05
Unilat. Control 1 with Alternate Strokes	3.48	.01
Unilat. Control 1 with Stroke with Rest	3.22	.01

investigation. Thus we see from an examination of the data presented in table 2, that all of the variants under study are superior to unilateral exercise. Three of the four attain a level of significance surpassing the criterion demanded.

The unilateral control was the only exercise administered more than once. It was performed at the beginning and end of the series. The time interval

between the first and second trial was six weeks. Functional capacity improved to a surprising degree. Since the variant forms of the exercise prescribed in the interim between these trials were performed only once weekly, it is difficult to attribute the gain in power either to morphological or physicochemical changes affecting the contractile tissues *per se*. Although no direct evidence applicable to the specific form of exercise used is available, *a priori* reasoning suggests that practice periods must be spaced more closely than they were to bring about the changes in the size and composition of muscle fibers which characterize training. It is postulated, therefore, that the augmentation observed in functional capacity is not myogenic, but the resultant of the facilitation of that galaxy of little understood central neural mechanisms to which the term *motor learning* is applied. The results suggest that in the interval between the first and second trial of the exercise under discussion, the subjects had been inured to the discomforts of an all-out effort, and had learned how to extend the intensity and duration of the efferent discharges emanating from cortical and subcortical reflex centers.

Performing the same exercise in alternate bouts, first with the preferred hand and then with the contralateral limb until the weaker side fails, increased total work output significantly above that attainable when the exercise was done unilaterally. The augmentation in work output was even greater when the individual strokes of each bout of 25 repetitive contractions were performed alternately. Functional capacity consistently reached its peak during this method of exercise. Some of the effect was doubtless due to the rest pause between strokes alternately enjoyed by one and then the other limb. That this was not fully compensated for by doubling the load increments may be seen by examining the results of the stroke with rest control procedure. Total work done was greater than that achieved by the standard control procedure.

Total work done when performing the exercise by alternate strokes regularly superseded that attained when the exercise was executed unilaterally at the same rhythm, each stroke being followed by a rest pause. Figure 1 schematically illustrates these time relations. The results are in line with Marschak's[6] observations and those made earlier by Setchenov and other Russian workers whose studies are reviewed by Marschak. They found that so-called *active recuperation* is more reviving than *passive recuperation*. Repetitive bouts of ergographic work, as performed by Marschak's two subjects, were separated by rest pauses of 20-30 seconds. During passive recuperation both extremities were at rest, whereas during active recuperation either the ipsilateral or the contralateral extremity performed light, rhythmic exercise. When the rest period was utilized for severe exercise, there was a diminution in subsequent performance. The exercise used in the present series of experiments increased progressively in severity. The data have not yet been subjected to detailed analysis to determine whether facilitation was superseded by inhibition as the load lifted grew increasingly heavy. This may account for the statistically insignificant difference between total work done during the alternate stroke and stroke with rest procedures. In their terminal phases these two types of exercise were always severe. Indeed, cessation of activity was not infrequently the result of pain rather than fatigue. Although the wrist joint extensors could still lift the load, the finger flexors were too weak to grasp the handle through which the lifting force was transmitted to the wheel and axle of the ergograph. This resulted in intolerable pressure on the distal phalanx of the thumb, which was forced to sustain an

6. Marschak, M. E.: Experimentelle Untersuchungen Über den Einfluss der aktiven Erholung aus die, Arbeitsfähigkeit des Menschen, Arbeitsphysiol. **6**:664, 1933.

increasingly heavy load during wrist joint extension. Nociceptive impulses are known to be inhibiting.

Performance of the prescribed exercise reciprocally had less effect on functional capacity than either alternate bouts or alternate strokes when compared with the unilateral control. However, the difference was significant. The "t" score of 0.05 is sufficiently high to show that a true difference exists. It required considerable skill to perform wrist joint extension reciprocally at the standard rhythm. The subjects were given no opportunity for practice other than to get the feel of the exercise before being strapped into the ergograph. Once the subject got into the swing of the exercise it was difficult to stop abruptly on the twenty-fifth stroke, which terminated each bout. The tendency to overshoot was repeatedly observed. Body weight was involuntarily shifted from one ischial tuberosity to the other, moving toward the side engaged in lifting the load. This overflow of activity was augmented as the loads grew progressively more heavy.

It was the general impression of the observers that reciprocal exercise may have had a more augmenting effect on endurance than extent of contraction. Since the duration of exercise per bout was standardized, this factor could not be studied in the series of experiments herein reported. Its possible utility for increasing work tolerance warrants study, since the reciprocal use of the limbs in the performance of simple normal range movements is a well established and fundamental activity pattern.

To attain greater homogeneity in the grouping of subjects utilized for this study, the results of the males were separated from those of the females (table 3). Because some of the males did less work than the strongest females, the total group was then subdivided into three mutually exclusive categories as regards mean strength, disregarding sex (table 4 and figure 2). The reduction in the coefficient of variation is especially evident in this sub-classification. The "t" scores were then computed and are presented in table 5.

TABLE 3. — *Sex Differences in the Influence on Ergographic Work Capacity of Variations in the Method of Performing Identical Exercise.*

	Males				Females			
Method of Exercise	No. Cases	Mean Total Work Kg.m.	Sigma	V	No. Cases	Mean Total Work Kg.m.	Sigma	V
Unilat. Control 1	25	168.44	62.07	36.85	22	101.68	60.05	59.06
Alternate Bouts	25	220.96	86.22	39.02	23	141.87	50.08	35.30
Reciprocal Ex.	25	218.00	82.70	37.94	23	123.22	39.57	32.11
Alternate Strokes	25	252.52	98.84	39.14	23	140.52	57.59	40.98
Stroke with Rest	25	248.12	99.35	40.04	23	138.48	69.57	50.24
Unilat. Control 2	14	219.64	99.29	45.21	14	145.86	65.45	44.87

TABLE 4. — *Influence on Ergographic Work Capacity of Variation in the Method of Performing Identical Exercise by Weak, Intermediately Strong, and Strong Subjects.*

	Weak				Intermediate				Strong			
Method of Ex.	No. Cases	Mean Total Work Kg.m.	Sigma	V	No. Cases	Mean Total Work Kg.m.	Sigma	V	No. Cases	Mean Total Work Kg.m.	Sigma	V
Unilat. Control 1	11	73.45	22.00	29.95	24	124.75	37.61	30.15	12	220.50	68.81	31.21
Alternate Bouts	12	103.08	23.01	22.32	24	165.58	26.78	16.17	12	298.00	66.03	22.16
Reciprocal Ex.	12	96.17	24.57	25.55	24	157.79	54.45	34.51	12	278.58	46.63	16.74
Alternate Strokes	12	118.08	31.52	26.69	24	171.83	48.76	28.38	12	333.67	85.57	25.65
Stroke with Rest	12	107.00	25.18	23.53	24	165.63	54.97	33.19	12	344.08	58.90	17.12
Unilat. Control 2	7	104.00	31.92	30.69	13	172.15	58.49	33.98	8	281.38	75.04	26.67

The weaker females did not gain as much through motor learning as did the males, who are more accustomed to doing physical work of a competitive nature. The change in the method of performing the prescribed exercise was not significantly augmenting when the women did reciprocal exercise or when

TABLE 5. — *Comparison of the Total Work Done by the Right and Left Hands During Various Methods of Performing Identical Exercise with Unilateral Control Observations.*

Methods	Weak "t"	P	Intermediate "t"	P	Strong "t"	P	Males "t"	P	Females "t"	P
Control 1 with Control 2	2.07	.05	3.78	.01	1.73	.10	2.08	.05	1.99	.10
Control 1 with Alt. Bouts	3.02	.01	4.24	.01	2.70	.02	2.42	.02	2.40	.05
Control 1 with Recip. Ex.	2.24	.05	2.40	.02	2.32	.05	2.35	.05	1.40	.10
Control 1 with Alt. Strokes	3.79	.01	3.67	.01	3.41	.01	3.53	.01	2.18	05
Control 1 with Stroke with Rest	3.25	.01	2.95	.01	4.52	.01	3.33	.01	1.87	.10

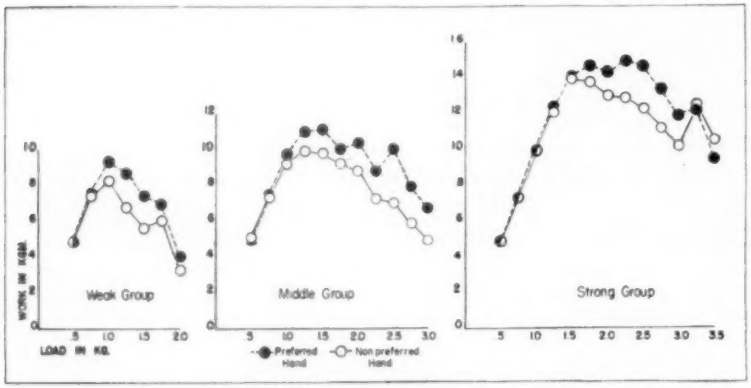

Fig. 2. — Mean curves of work of the weak, intermediate and strong groups when performing the initial unilateral control exercise. Each point represents the mean work done in 25 repetitive maximal contractions against the resistance indicated.

passive recuperation was introduced between strokes. The group of intermediate strength demonstrated the most uniform effects with change in method of performance (figure 3). The weak responded somewhat more markedly than the strong, which is to be expected. The superiority of alternate strokes for the facilitation of work output is now more clearly evident and alternate bouts remain more capable of eliciting augmentation than reciprocal exercise.

When a load slightly in excess of the optimal is selected and held constant, work capacity falls off with each successive bout of twenty-five repetitive contractions. The decrement is at first rapid and then levels off at the 6th or 7th bout to 30 or 40 per cent of the initial value. To illustrate the facilitating effect of active recuperation, the following experiment was performed. The non-preferred hand of trained and untrained subjects was made to perform twenty-five repetitive contractions with a passive rest pause between each stroke. After the standard thirty second period of rest, the bout was repeated, substituting alternate strokes for the stroke with rest technique of performing the exercise. Thus the odd numbered bouts exhibit the influence of passive recuperation and the even numbered bouts the influence of active recuperation. Figure 4 shows the reviving effect of the

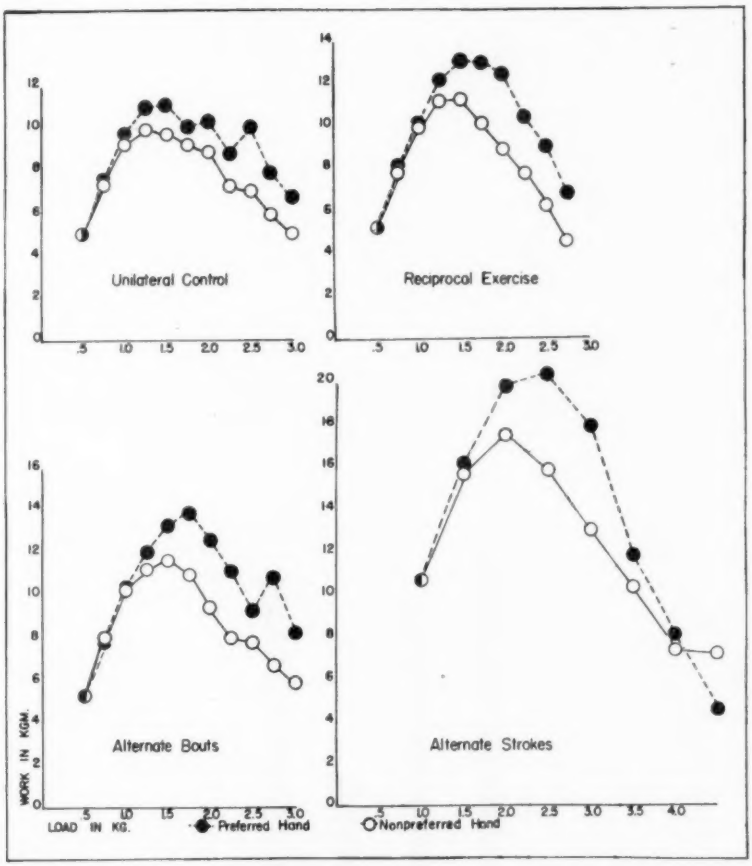

Fig. 3. — Mean curves of work yielded by the group of intermediate strength illustrating the influence of variation in the technique of performing repetitive wrist joint extension against graded resistance.

latter procedure. The smoothly dropping fatigue curve demonstrates a sharp reversal in trend each time the contralateral limb is made to exercise alternately with the extremity being studied. The evidence suggests that the superiority of the alternate stroke procedure is not due to the rest allowed but to the facilitating effect of the muscular contractions of the opposite extremity during the momentary pause between strokes.

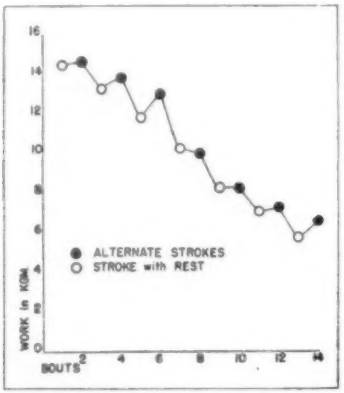

Fig. 4. — Fatigue curve illustrating the decrement in the functional capacity of the non-preferred limb when a constant load is lifted and lowered in 14 successive bouts of 25 repetitive contractions each. A rest pause of 30 seconds was interposed between each bout.

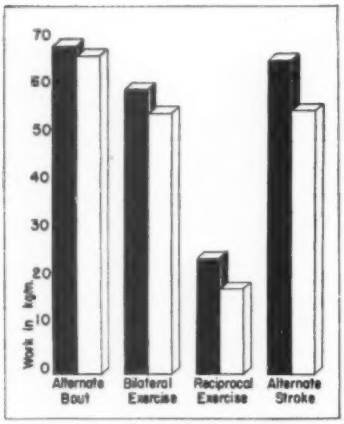

Fig. 5. — Column diagrams illustrating the total work done in 4 successive experiments following a standard unilateral limit day test. Each experiment entailed an all-out effort. The series was followed by severe muscle soreness. The black columns represent the functional capacity of the preferred extremity; the white columns, the contralateral limb.

The relative merits of the different methods of performing the exercise under study was demonstrated in yet another way illustrated in figure 5. A standard limit day procedure was performed by a group of male subjects, first with the preferred and then with the non-preferred hand. Selecting the heaviest load which could be carried twenty-five times in the prescribed rhythm, four experiments were performed in succession, varying the manner in which the exercise was administered as follows: alternate bouts, bilateral exercise, reciprocal exercise, and alternate strokes. The sequence of the series was held constant for all subjects. Each experiment entailed an all-out effort. A fifteen minute rest pause was permitted between experiments. This was not sufficiently long to allow complete recuperation. In spite of increasing exhaustion, the final procedure, which utilized the alternate stroke technique, was invariably associated with a striking revival in power.

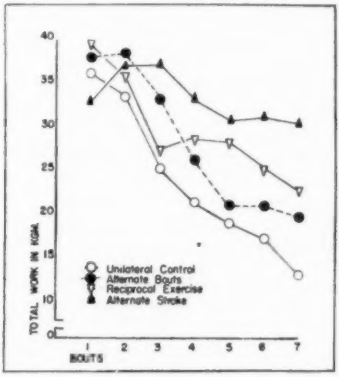

Fig. 6. — Fatigue curves illustrating the decrement in the work done by the right and left wrist joint extensors when a constant load was lifted and lowered in an equivalent number of successive bouts by a well trained subject. The experiments were performed on successive days.

The series of experiments illustrated in figure 6 was performed by a well trained male subject. The procedure was like that already described, except that the four experiments were done on successive days. By comparing the initial with the final work output in an equivalent number of bouts, it can be seen that whereas unilateral exercise was associated with a 63 per cent decrement in work done per bout, the alternate stroke procedure demonstrated only an 8 per cent reduction in functional capacity. The alternate bout and reciprocal exercise data fell approximately midway between these extremes. Thus it can be seen that a simple change in the way in which a simple exercise is performed, may have a profound influence on the amount of work done.

Kabat[7] has recently summarized the experience of his group in the development of new techniques of expediting recovery of voluntary motor function in the presence of paralysis of different types and has elucidated their rationale. In this review Kabat emphasizes the importance of utilizing mass movements and various reflexes to facilitate central stimulation. During the conduct of the experiments here presented, particular attention was given to

7. Kabat, H.: Central Mechanisms for Recovery of Neuromuscular Function, Science, 112:23 (July) 1950.

the character and extent of all subsidiary movement patterns emerging spontaneously in the course of progressively more and more severe exercise performed rhythmically against measured resistance. Among the most frequently observed involuntary movements was a turning of the head toward the limb performing maximal wrist joint extension. The reverse head movement never occurred. During bilateral exercise the head moved backward. Shifts in body weight during reciprocal exercise have already been described. Synergistic cocontractions of the lower extremities also occurred. The probable significance of these and other overflow patterns will be discussed elsewhere. That their importance has been overlooked in the planning of rehabilitation procedures is becoming increasingly evident. Restriction of attention to the meticulous re-education of isolated muscles may obscure total patterns of response capable of eliciting therapeutically useful synkinetic movements. There can be no doubt that central mechanisms play a decisive role in the augmentation of work ouput.

Summary and Conclusions

A series of 359 ergographic experiments was performed on a group of 52 normal adult subjects for the purpose of studying the influence on work capacity of variation in the method of performing simple repetitive exercise. Wrist joint extension was carried out against progressively increasing resistance until the requisite number of contractions could no longer be executed at the prescribed rhythm. The sum of the work done unilaterally by the preferred and the non-preferred limb was compared with the functional capacity of the same muscle groups when the exercise was performed in alternate bouts, reciprocally or by alternate strokes. The duration of exercise was the independent variable. The evidence presented supports the following conclusions:

1. Change in the way in which a normal range movement is performed repetitively against progressively increasing resistance, exercises a significant influence on the functional capacity of the muscle groups involved.

2. All variants of the standard exercise were superior to unilateral performance.

3. Augmentation in work output was greatest when the exercise was performed by alternately contracting homologous muscle groups of the preferred and the non-preferred limb.

4. So-called passive recuperation did not account fully for the change observed.

5. Active recuperation appears to be significantly dynamogenic whether introduced in the form of alternate strokes, alternate bouts or reciprocal contraction.

6. It is postulated that the augmentation in functional capacity observed is due to central facilitation and is affected secondarily by spontaneous synergistic cocontractions following a number of clearly defined reflex patterns. How much of the effect is due to psychologic factors incidental to shifts in attention remains yet to be studied.

Acknowledgments: Interest in this subject was stimulated by unpublished work of Angel Mary Krikorian, who performed preliminary experiments on the facilitating influence of alternate stroke exercise in this laboratory during 1948-49. The technical assistance of Catherine C. Deane is gratefully acknowledged. Credit is due the group of physical therapy students, without whose intelligent and interested cooperation this study could not have been conducted.

REHABILITATION AND THE PRACTICE OF MEDICINE *

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Fortunately, patients overcome minor disabilities with little or no assistance beyond routine medical care. The needs of more seriously disabled or chronically ill patients can be satisfied only by special medical rehabilitation techniques and with the help of non-medical rehabilitation specialists.

Most of the men who produce the basic fuel of our industry risk their lives daily. Too often their reward is death, or tragic disablement. Sometimes disability results from a cave-in or explosion. Often it comes on more insidiously as a result of chronic insult to the lungs, heart, joints, and the nervous system. The backlog of broken and worn out bodies in the basic industries continues to increase. The resultant social disintegration is appalling.

The prolonged unemployment and excessive medical expense that accompany severe disabilities often lead to economic ruin and permanent destruction of the family. It is therefore imperative that the practicing physician understand the total problem of the severely disabled patient. Once he achieves this understanding he is better equipped to make available the modern rehabilitation services which can prevent these social tragedies.

Rehabilitation should mean the speedy social reintegration of the disabled at the highest productive level, or at the least dependent non-productive level. "Social reintegration" means returning to the job which illness or injury interrupted, resuming previous social status in the family, and returning to normal community life. "At the highest productive level" means returning to an occupation which permits independence and self-sufficiency.

The more severely handicapped patients cannot all be rehabilitated to productivity. Most of these can, however, be helped to attend to their own daily needs. Thus a wife or son may be released from nursing duties and enabled to contribute to the economic preservation of the family. Paraplegics, bedfast for years, have been helped to attain a wheelchair or ambulatory existence and have assumed responsibility for housework, cooking, and the supervision of young children. This is social reintegration at a dependent level.

The Role of the Family Physician. — While we have defined rehabilitation in sociological terms, and the physician may feel we have strayed beyond his province, the family physician is often the first to be consulted by the disabled patient. Having the confidence of his patient and an understanding of the family situation, he has an excellent opportunity to make the first over-all evaluation of the patient from a rehabilitation standpoint.

* Presented at the Thirty-ninth Annual Clinic of the John A. Andrew Clinical Society, Tuskegee Institute, April 10, 1951.

To do this the physician must understand not only the signs and symptoms of disease, but the total individual and his environment. The patient's skin encloses his whole family and all his problems, and the physician must know what is happening beneath the skin. He must share the patient's primary concern — his need to earn a living.

The rehabilitation-minded physician will therefore seek means of correcting disabilities promptly. He will want to know whether the patient has skills or education to draw upon in changing his occupation. Does the disabled individual live in a city with work opportunities or on a plot of ground that can be turned into a farm? Does he have a home that can be converted into a radio or watch repair shop? What community agencies can help him? Can he look forward to some assistance from his neighbors, employer, lodge, union, or the county welfare department?

Physicians who learn to probe to the heart of rehabilitation problems are really practicing social medicine. Many physicians still consider social medicine of only academic interest, but it is the sine qua non of rehabilitation.

The Front-Line Team. — The average physician will need assistance in making a rehabilitation evaluation, for the concept is new and is just beginning to receive attention in the medical school curriculum. The local physician should bring the local Vocational Rehabilitation Service counselor, the social worker, the public health nurse, and others, into the picture as soon as possible. He then becomes a member of the front-line rehabilitation team.

In every state, physicians can refer handicapped individuals to the State Vocational Rehabilitation agency. Referral need not be limited to the severely disabled, like the paraplegic. Less severe orthopedic and neurologic problems, cases of arrested tuberculosis, cardiacs, and other disabilities are eligible for vocational rehabilitation services. Counselors evaluate disabled adults, and make available necessary physical restoration services, training opportunities, advice, tools, and other services to help the handicapped become self-sufficient in a new job or business.

The family physician and the rehabilitation counselors in his community should work closely together. The physician provides a medical evaluation once the counselor makes clear the kind of data required. He stimulates the interest of his patients in vocational rehabilitation. He and the rest of the team decide which cases to refer to special rehabilitation centers, and provide follow-up services.

The public health nurse is trained to teach health care recommended by the physician. As a member of the front-line team, she, too, can assist in the evaluation of the rehabilitation problem. Her access to the homes of the community often provides valuable insight into family problems.

The community social worker is well equipped to evaluate the economic status of the family and to marshal whatever financial resources are available.

Representatives of the state employment service, unions, industrial concerns, and voluntary organizations, have assumed various roles in the local situation.

Who takes the responsibility for coordinating all the activities of the front-line team? Usually it is the Vocational Rehabilitation Service counselor. In our experience the physician rarely does. Sometimes a lodge, a union, an employer, or a service club, coordinates the efforts of all members of the team. Usually the agency which pays for services does the coordinating.

Cooperation Between Physicians and Group Practice. — The rehabilitation of amputees, paraplegics, severe arthritics, and other severely disabled individuals requires close cooperation between the local physician and specialists with training and experience in the management of complex rehabilitation problems.

Cooperation between physicians in rehabilitation is imperative, but not always easy to achieve. Physicians are inclined to be individualistic and independent, but a paraplegic with muscle contractures, ankylosed joints, bladder and bowel incontinence, renal and bladder stones, huge decubiti, lost libido, morphine addiction, and a suicidal paranoia, cannot be helped much by medical individualists. Such a patient needs the combined skills of a smooth functioning team of medical specialists working together according to a flexible coordinated plan, and not simply treating him in succession. The example is extreme though not rare, and it demonstrates the utter futility of individualism or solo practice in the medical management of severe disabilities — it is evidence that speedy rehabilitation of the severely handicapped is next to impossible without well coordinated group medical practice.

The Specialist. — In most rural communities or small towns, there are few real specialists or medical groups, and the local rehabilitation team will need the assistance of individual specialists or groups in neighboring cities. The specialist or group must also work closely with the Vocational Rehabilitation Service representatives and others, and should understand the kinds of medical information and treatment needed. The general hospital rehabilitation ward, if properly equipped, and staffed with a well-coordinated team, may be the answer to the rehabilitation needs of many smaller communities.

The Rehabilitation Center. — In our experience the soundest method of rehabilitating the severely disabled is through the use of special rehabilitation centers. These are equipped to meet most of the problems of the handicapped patient, and the practice of medicine in such centers probably represents social medicine on a plane never before achieved.

The Institute of Physical Medicine and Rehabilitation of New York combines the skills of a medical school-affiliated group and outstanding research fellows with those of specialists in vocational counseling, psychological testing, social welfare work, physiotherapy, and others, in a splendid physical plant. This center, the Kabat-Kaiser Institutes in California and Washington, D. C., The Kessler Institute of Rehabilitation in New Jersey, and the George Washington University Hospital in Washington, D. C., are pioneering in the restoration of severely disabled civilians to social usefulness.

The Woodrow Wilson Rehabilitation Center in Fishersville, Virginia, operated by the Virginia Division of Vocational Rehabilitation, accepts only cases which have already received most of their medical treatment. Medical care is limited primarily to physical medicine, and physiotherapy, occupational therapy, and vocational training are emphasized.

Coordination in Rehabilitation Centers. — There are problems of coordination among rehabilitation specialists in special centers. The solution of these problems requires the willingness of each member to test his views against those of the rest of the group. Wherever a number of rehabilitation skills are brought into play for the welfare of the individual patient, whether these specialists are associated under one roof or not, some one person must take responsibility for coordination. Whether the coordinator is a doctor of physical medicine, a neurologist, an orthopedist, an internist, or an administrator, matters little. The coordinator must understand the total rehabilitation plan, command the respect of those providing care, and have the ability

to integrate and regulate the chronology of the medical, vocational, physiotherapeutic, and other services to the best advantage of the patient.

Coordination Between Levels. — One of the rehabilitation problems we have experienced is the need for closer coordination between the front-line team, the specialists, and the special centers. The special center staff must be supplied with complete reports by those familiar with the patient's home and community situation, and local physicians and counselors must be kept currently informed of the progress of the cases receiving treatment by specialists, or in special centers.

For example, if the patient in the special center shows an interest and aptitude to become a photo retoucher, the local counselor must be consulted to determine whether there is a potential demand for this skill in the home community. The local counselor will have to know approximately when to expect the patient's release from the center, for he may have to plan to move the patient's family from an isolated to a more populous neighborhood, to obtain equipment and supplies, and to make arrangements with photographers to provide the patient with work. Similarly the local physicians require reports and advice to prepare them for follow-up care, e. g., arthritics often leave special centers with instructions to have laboratory tests performed at intervals, and medication adjusted; painful amputation stumps require observation, and bladder infections, so frequent among paraplegics, may need treatment. Paraplegics, in particular, need constant encouragement to continue exercises, and should be reminded to be on the lookout for beginning decubiti. In view of the investment in time and effort in each special center case, retrogression must be prevented at all costs. The local physician can help to prevent retrogression, and should be in a position to suggest a return to the special center when its prevention seems impossible. The return of patients to special centers must be synchronized with the vocational training program so that progress toward a job or business objective will not be unnecessarily interrupted.

The problem of coordination among physicians is not peculiar to rehabilitation. It is inherent in individualistic medical practice. A partial solution advanced is the regionalization of all health services. Regionalization plans providing for the integration of rehabilitation centers and medical colleges, along with general hospitals, health departments, and physicians into a program which will offer first-rate quality of service and continuity of care, will increase rehabilitation potentialities tremendously, but only if the effects of individualism are minimized.

Payment. — Nothing has been said about payment for rehabilitation services, but without payment for local, specialist, and special center services, there can be little rehabilitation. Very few severely disabled individuals can finance their own rehabilitation and no available health insurance can cover the expense. Private agencies providing rehabilitation services are a new and growing primary resource for portions of the population. The Federal and State Vocational Rehabilitation agencies, and occasionally Workmen's Compensation Boards, provide public funds for rehabilitation, but still the backlog continues to grow. Perhaps the question of payment will be more satisfactorily resolved when it becomes more generally agreed that total rehabilitation is a matter of individual right.

Results. — Those who have not seen the results of special rehabilitation techniques cannot be blamed for doubting what can be accomplished with the severely disabled. However, skepticism is steadily disappearing as more and more remarkable comebacks are demonstrated. For example, Dr. Rusk

Fig. 1.

describes a series of 21 quadriplegics, 17 of whom were returned to a gainful occupation. Forty per cent of a series of 100 hemiplegics were returned to a gainful occupation and ninety per cent learned self-care and ambulation.[1]

The following case illustrates a serious rehabilitation problem. S. H. is a forty-eight year old Negro male with a wife and five children. He had no classroom education beyond the eighth grade in elementary school, and entered the coal mines in 1916 at the age of 13. He worked for 20 years without missing a single day's work. In an underground collision on September 10, 1938 his thighs were pinned between two motors for 1½ hours. Bilateral mid-thigh amputations became necessary.

Since the employer was legally obligated to provide medical care, the patient was the responsibility of the company's doctors. After 2 months' hospitalization, he returned home confined to a wheelchair. He was not again seen by a physician until eight years later.

After three months at home, he was given a pair of artificial limbs, but no instruction in their use. He made several attempts to wear them, but the sockets were too big and the limbs were too heavy. Since the medical care allowance under the compensation law had been expended, the patient had to pay $300.00 for these useless appliances, which was withheld from his compensation check at the rate of $2.00 a week.

He received a net compensation payment of about $11.00 a week for 400 weeks. With this income he had to help support his family. While his wife was at work he took care of the children and did the cooking, cleaning, sewing, ironing, etc.

Fig. 2.

Several problems are apparent at this point.

1. No one had given any thought to rehabilitation as we have defined it; the patient had achieved a sort of partial self-rehabilitation.

2. No special physical rehabilitation techniques or vocational counseling was provided during the first eight years after the injury.

3. The state compensation law at the time provided a maximum of $200.00 for all medical care in injury cases, which fell far short of this patient's needs.

S. H. was a 220 pound active muscular man when he became disabled. With the vegetative existence that followed the loss of his limbs, his weight increased to 273 pounds.

1. Samuel S. Sverdlik, M.D.; Howard A. Rusk, M.D., New York, N. Y. Rehabilitation of the Quadriplegic Patient, J. A. M. A., 142:321 (Feb. 4) 1950.

This patient was called to our attention in 1948 by fellow Union members. His case was evaluated and referred to the Alabama Vocational Rehabilitation Service, and on May 28, 1948 he was sent to the Kessler Institute of Rehabilitation in Newark (now at West Orange), New Jersey. After examination by a team of medical consultants, vocational counselors, and others, arrangements were made for medical and dental care. The first objective was to make him ambulatory to speed up weight reduction.

After three months the patient's training was interrupted when he returned home because of the severe illness of one of his children. He returned to the center shortly and after two months became homesick. He wanted to leave, but a member of his family traveled to New Jersey and encouraged him to stay.

A counselor of the New Jersey Vocational Rehabilitation Service completed the vocational evaluation at the Institute and the patient and center staff decided that he might operate a restaurant or shoe repair shop. The first seemed more suitable "in view of the fact that client possesses an outgoing personality which would be favorable to this choice. In addition, client would have assistance from his older child and wife The latter has had restaurant, cook, and candy store experience."

On returning home, S. H. was seen again by representatives of our office and the vocational rehabilitation service counselor. His local doctor treated him for a minor shoulder complaint. A special amputee consultant for the Kessler Institute, himself an amputee, visited the patient late in 1948 and spent a week teaching him better ambulation.

He returned to the Institute in May, 1949 as planned after a period of self-training at home. After three more visits to the Institute for adjustment of stumps, artificial limbs, diet, and training program, and after continued supervision by local medical consultants, the patient made remarkable progress. In three years he brought his weight down to 175 pounds. Today he can walk with the aid of only one Canadian crutch. We believe he has achieved about the maximum modern medicine has to offer a bilateral above-knee amputee.

This patient is not yet completely rehabilitated, and depends upon a monthly rehabilitation grant from the United Mine Workers of America Welfare and Retirement Fund. The restaurant has not materialized. A vacant lot across from his home is available and suitable for a lunchroom, but the Vocational Rehabilitation Service is not permitted to put up a building.

He was offered a job as an elevator operator in a Birmingham building. He could not accept it because it paid only $17.00 a week for 10 hours a day, and because taxi fare to the nearest bus would have come to $7.00 a week.

S. H. tried to get work around the mines; he was turned down, although there are jobs available he can fill, because the employer wants young, able-bodied men.

He is well motivated and physically restored, but he has not yet been socially reintegrated by any existing agency. The only hope for him is a plan originated by his Union friends. They are considering buying a building from an abandoned mining camp, dismantling, moving, and setting it up as a restaurant. This is laudable, but working people cannot assume many such burdens.

What are some other rehabilitation problems illustrated by this case? For one thing, the Vocational Rehabilitation Service program is too narrow

in scope. The community in which the patient lives is too isolated from public transportation. His job opportunities are sharply limited by many obvious social and economic factors. Why is he denied the protection of the minimum wage law? How can employer prejudice against the handicapped be overcome? If all rehabilitation measures fail, should we recognize a patient's right to financial aid which will bridge the gap between permanent loss of earning power and a decent existence?

The problems of S. H. and other severely disabled individuals cannot be solved by the physician alone. But it is his responsibility to understand them, and to cooperate with his colleagues and others for the maximum rehabilitation of the patient.

Summary

Rehabilitation is defined as social reintegration at the highest productive level, or at the least non-productive level. The concept of the family physician working toward this end as a member of the local community team together with Vocational Rehabilitation Service counselors, public health nurses, social workers and others, is presented.

The role of the specialist, medical group, and rehabilitation center is outlined, and the importance of team work at every level and the urgent need for coordination between levels are emphasized.

A case is presented to exemplify the rehabilitation problems of a severely disabled individual.

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.·. EDITORIAL .·.

EVERY PHYSIATRIST IS A GERONTOLOGIST — OR SHOULD BE!

Hitler's method of eliminating old people was considered by some as the most practical means of solving society's problem of the aged; another suggestion is to stop medical scientific efforts so that not too many people will live to become old; or the practice that occurs in certain parts of India where old persons are thrown over a cliff, could be advocated; and other equally "effective" programs might be used, but fortunately none will ever be tolerated in a civilized state. Thus old people exist and from all statistics, their number is gradually increasing.

At the present time in the United States almost eleven and a half million persons are 65 years of age and over, which is almost 8 per cent of the total population. Since 1900 the population of the United States has doubled. whereas, the number of persons of 65 years and over has almost quadrupled. By 1960 this group will number almost 15,000,000 and by 1975 almost 20,000,000. The admissions of patients over 60 at the Peter Bent Brigham Hospital in 1913 was 1 out of 16, whereas, in 1943 it was 1 out of 5. Other examples could be given to show there are more older people today.

Gerontology might be defined as the study of the phenomena of aging and includes the biological, biochemical, physiological, pathological, psychological and last but not least the social and economic aspects of aging. T. H. Howell succintly defines gerontology as the "knowledge of the normal changes in body and mind which make up senescence." Thus aging is a normal process. Since not all persons age normally, the subject of geriatrics is closely associated with gerontology. Geriatrics is defined as the study of the way elderly persons, react to disease and the best methods of treating their maladies.

Gerontology and geriatrics are really not new. Hippocrates, who is usually credited with considerable erudition, said this in his time, "Old men suffer from difficulty of breathing, catarrh accompanied by coughing, strangury, difficult micturition, pains at the joints, kidney disease, dizziness, apoplexy, cachexia, pruritis of the whole body, sleeplessness, watery discharge from the bowels, eyes and nostrils, dullness of sight, cataract and hardness of hearing." This about covers the infirmities of the aged. One of the earliest volumes on old age was written in Latin by Roger Bacon and first translated into English in 1683. Floyer's Medicina Gerocomica, in 1724, the first work concerning the treatment of diseases of older persons, is usually considered the foundations of geriatrics. Since then several notable books have appeared. Charcot's Diseases of Old Age was published in 1881, and the Germans have five volumes that are ranked as notable contributions. Jacobi, best known for his interest in pediatrics, was keenly interested in geriatrics. In more recent times several books have been published — most notably are those of Thewles (five editions), Stieglitz, Boas and Cowdry.

However, it is only during the past 10-15 years that the medical profession has really become aroused with the need for the welfare of the aged.

The American Medical Association's interest in the problem is evident in its various activities — they realized the importance for caring for and rehabilitating the aged persons by their various programs, particularly for the Commission on Chronic Illness.

More and more hospitals are being erected for the care of the aged and chronic patients. These are hospitals in the true sense of the word rather than merely institutions for custodial care. Most of them are general hospitals, often affiliated with a medical school. These arrangements provide satisfactory diagnostic and therapeutic procedures as well as facilities for valuable research investigations.

During the past few years the state health departments have recognized the importance of maintaining the health of the older people. The states with most active programs include New Jersey, Massachusetts, Connecticut, Illinois, Maryland, New York, Indiana and California. Several cities have organized programs for determining the medical needs in their communities. For instance, a Central Service for the chronically ill was organized in Chicago in 1944 and in Philadelphia and Milwaukee in 1947. Other cities that have initiated similar studies are Cleveland, Pittsburgh, St. Louis and New Haven — to mention only a few.

Research projects are being conducted both abroad and in this country. In Great Britain, three research units are examining various problems; for example, at Cambridge University, the psychological factors are being investigated; at Edinburgh, the skin in old age, arteriosclerosis and some basic processes of aging are being studied; whereas, at Oxford, the effects of hormones and waste metabolic products on aging are under investigation. Great Britain also has seven geriatric units in different cities where special efforts are made for treating these elderly patients. The Nuffield Foundation has supported the various research problems of the aging most generously. Denmark has four research units functioning in Copenhagen. A notable institution is the "Old Peoples' Town" at which excellent hospital and research laboratories are available. The French Society has three laboratories for gerontological research — the laboratories of physiology and medical biology of the University of Paris, and the Radio Institute of Professor Lacassagne. Holland has eight research centers in Amsterdam, Utrecht and Leyden Universities. Belgium has six research units. Spain has a chair of gerontology in Valencia University and so has Czechoslovakia in Prague University. In Sweden a group of scientists from the Royal Cell Institute and University Psychiatric Clinic in Stockholm are experimenting on the nervous system, chiefly of the brain of the aged.

Many institutions in the United States have departments where aging represents one of the primary research interests. At the Worcester Foundation in Shrewsbury, Massachusetts, two notable problems are being investigated, namely, a study of the aging process on the ability of the individual to handle physiological and psychological stress situations, and a study in variations in steroid hormone excretion. Columbia University has been conducting studies on atherosclerosis by means of tissue culture methods and the relationship of the adrenal cortex to hypertensive cardiovascular disease. Cornell University Medical School has been interested in a long term study of the effect of age on the production of the vaso-excitor and depressor substances produced in the liver and kidney. They also are investigating the relationship between diet and longevity.

The U. S. Public Health Service has initiated a vast program at Baltimore City Hospital with Dr. N. W. Shock as Chief of the Unit. The unit will consist of two wards of 66 beds, all for research purposes. The Home

for Indigent Aged, which is on the same grounds, and which houses 600 persons, will also be used. The research goals include the study of changes produced with age in the environment, study of alterations in the functional capacities of organs and tissues with age, and others. At Washington University School of Medicine in St. Louis, a most active program under the direction of Doctors Cowdry and Kountz has been started. In July, 1948, a sum of $1,400,000 was granted to carry out research on gerontology and related fields. The University of Minnesota has two major interests; one, the effect of diet on aging; and, two, the studies on normal aging in human beings by using normal persons living in the community. These are merely a few examples — numerous other universities and clinics are conducting research projects along many and varied disciplines. All of this is encouraging and will undoubtedly accelerate advances in the knowledge of gerontology and geriatrics.

The increasing number of scientific sessions and conferences devoted to the problems of aging, both for the professions and for lay persons, is an indication of awakening interests. The oldest conference group on aging was sponsored by the Josiah Macy, Jr. Foundation. They have had meetings since 1938. The University of Michigan has offered lecture courses on "Living in the Later Years" under the leadership of Clark Tibbitts and Wilma Donahue, outstanding leaders in the field of gerontology, which have been unusually successful. In Baltimore an exhibit entitled "Baltimore Comes of Age" was prepared by the Peale Museum. A series of four lectures at weekly intervals accompanied the exhibit and was given before capacity houses.

One of the first gerontological societies was established in England in 1939. A group of British scientists and medical authorities formed the International Club for Research on Aging. In the United States the American Gerontological Society was founded in 1944 and now has more than three hundred physicians, scientists and other workers concerned with elderly people. In 1940, the American Geriatric Society was established by physicians who are interested in the diseases of the older persons. In July, 1950, the first International Congress of Gerontological Societies was held in Liege, Belgium. Fifteen different countries were represented. The second International Congress was held in St. Louis in September, 1951. During the five days of this meeting more than ten different sessions were held simultaneously from morning until night. Forty-six countries sent representatives to read and discuss scientific papers.

Does all this appear to be beyond the immediate interests of the physiatrists? Of course not! Any development or information that will improve the knowledge about the aged will benefit the physiatrist; but more than that, is not the physiatrist, more than any other medical specialist, the one who frequently treats elderly patients with their rheumatic disorders, vascular lesions, traumatic conditions, metabolic diseases, and the varied degenerative neuromuscular processes? What department of Physical Medicine in a general hospital, with the possible exception of the armed services, is not devoting an ever increasing amount of its work for the care of the patients who are past middle life?

In the past, the physiatrist has confined his interests to the definitive physical measures to help these patients — all with much success and satisfaction. He learned by experience that physical measures for the older patients must be specifically prescribed for them. Their reaction to heat and cold is frequently diminished; exercises must be gauged to their limitations; ultra violet light radiation varies for these patients; and precautions must be considered for other physical agents.

Although valuable investigations have been carried on in the field of physical medicine during the past few years, many of the reactions of the aged to specific physical agents has been relatively neglected. Research projects should be conducted for physical and occupational therapy as applied to geriatrics. It is a most fertile field for exploration.

Important as the definitive use of physical measures may be in restoring this group of patients to normal function, these agents in themselves, do not always restore these patients to a normal existence compatible with their age. This requires, in part, an understanding of the psychological reaction of the aged. This factor is of great importance but is too often disregarded. It definitely influences the response to therapy and should be of particular concern to the physiatrist.

There are so many old people whose feebleness, forgetfulness and frailities are accounted for solely by the condition of their arteries, joints or other organs. To be sure, definite pathology may persist, but does it always account for the failure of the patient to return to the form of living he experienced before he was made ill by his disease or disorder? They often can be improved physically but what can done to bring about their acceptance and "willingness to be rehabilitated"? Motivation is often most difficult to arouse in this group of patients. Too often older patients are afraid of recovery. To them their sickness has become a barrier against the outside world. Therefore it is not enough merely to treat the disease or disability. Perhaps at times psychotherapy is more important than physiotherapy. Ways and means must be found to find a place in the world outside of the hospital or sick room which will be satisfying to this type of patient. This calls for cooperation from many groups. In the first place, the family must be sufficiently interested so as to take an active part in the care of their sick old folks. As Dr. Howell expressed "Relatives who have regarded their Aunt Nellie as incurably crippled have to be interviewed. The situation must be explained to them and their help must be enlisted, otherwise Aunt Nellie will put herself back to bed because life is so difficult outside it." Any physiatrist who has assisted in the care of the aged in most chronic hospitals appreciates the lack of responsibility on the part of the family in helping in the rehabilitation of this group. This idea is expanded further by Dr. Monroe[1] who believes it is the duty of the doctor to "discover means of keeping them at work. If we find ways for them to rehabilitate themselves physically and intellectually, if they are given adequate care in sickness and convalescence and if they have normal opportunities for play, vacations, social association and community participation for living, many of them will retain their independence, and the break to custodial care will be of short duration or will not come at all." Certainly a physiatrist with his increasing activities and interest in rehabilitation of these people is the "doctor" who can best coordinate all these functions.

This requires community participation in more ramifications than can be dealt with in the editorial this month, and calls for what Dr. Grayson[2] says is a "task of the physician to mobilize all members of the team so that the maximum is obtained not only from the patient but from society as well"; and again the "physician" is the physiatrist.

This is a big order in caring for these older patients but by improving the specific physical measures, by adding a more comprehensive understanding of the psychological reactions, and last but not least, by including the functions of rehabilitation, thereby securing cooperation from many sources, a good physiatrist will become an excellent gerontologist.

1. Monroe, R. T.: Medical Problems of Old Age, N. Eng. J. of Med. 240:57 (Jan. 13) 1949.
2. Grayson, M.: Concept of Acceptance in Physical Rehabilitation, J. A. M. A. 145:893 (Mar. 24) 1951.

MEDICAL NEWS

Members are invited to send to this office items of news of general interest, for example, those relating to society activities, new hospitals, education, etc. Programs should be received at least three weeks before the date of meeting.

Latin-American Congress of Physical Medicine

The Fourth Convention of the Latin-American Congress of Physical Medicine will meet in Panama City, R. P., February 24th-29th, 1952.

The Latin-American Congress of Physical Medicine has been invited to hold its Fourth Congress in Panama City, the Capital of Panama, under the guidance of its Executive Director, C. L. De Victoria, M.D.

During the sessions of this Congress outstanding medical men, dental surgeons and pharmaceutical chemists will deliver a number of scientific papers pertinent to the latest development and techniques in the medical profession for the welfare of humanity. As the number attending this Congress will be limited, there will be ample opportunity to become better acquainted for the discussion of such problems as may be of primary importance to the Latin-American Countries.

Interested parties, desiring to participate and/or attend this forthcoming Congress of Physical Medicine in Panama City, next February 24th-March 9th, 1952, are invited to communicate direct with Cassius Lopez De Victoria, M.D., its Executive Director, at 176 East 71st Street, New York 21, N. Y. Phone No. Butterfield 8-6241, at their earliest convenience prior to December 25th, 1951, as applications will be considered in the order in which they are received.

Study of Irradiation Deformities

Under a grant from the National Institutes of Health, Dr. Stanley H. Macht is conducting a national survey of congenital deformities among radiologists and their children. The study will be based on a comprehensive questionnaire which will be sent to approximately 4,000 radiologists and other workers in the field of radiology, supplemented by another 4,000 to other physicians who do not come into contact with roentgen rays. The latter is to be used as a "control." The replies will be analyzed by competent biostaticians and the report will be issued by Dr. Macht.

All radiologists, specialists in Physical Medicine as well as other physicians, are urged to cooperate in this valuable study by promptly and carefully filling out and returning the questionnaires when they receive them. The series of questions is based on a pilot study which served as a guide in the preparation of the present enlarged and revised questionnaire.

Prize Offered for Paper on Cerebral Palsy

The Louis Lefkoe Memorial Foundation is offering a prize of $500.00 for the most worthwhile original contribution to the medical knowledge of Cerebral Palsy.

The paper may cover any aspect of the subject, such as pathogenesis, biochemical knowledge, pathology, diagnosis, treatment, etc., and is to be in the customary format for publication of medical literature.

Each contribution must be submitted to the trustees of The Louis Lefkoe Memorial Foundation, 601 Medical Arts Building, 16th and Walnut Streets, Philadelphia 2, Pa., on or before September 1, 1952.

Accepted Devices

Birtcher Electrosurgical Unit 799-H. — Manufactured by The Birtcher Corporation, 5087 Huntington Drive, Los Angeles 32, Cal., generator is designed for use in all techniques of electrosurgery. Evidence was obtained indicating the device gave satisfactory results in operation such as transurethral prostatic resection. The Council on Physical Medicine and Rehabilitation voted to include the apparatus in its accepted list.

Special Formula Cruricast Bandage. — Manufactured by E. K. Demmel Co., Inc., 59-11 67th Ave., Brooklyn 27, N. Y., gauze bandages are impregnated with a zinc gelatin paste, used in treatment of circulatory disorders of the legs. The Council on Physical Medicine and Rehabilitation voted to include the bandage in its list of accepted devices.

Lectron-O-Scope. — Manufactured by Electronic Stethoscope Corporation, 1316 Sherman Ave., Evanston, Ill., electrical device can be substituted for the bell of an ordinary stethoscope in order to amplify the sounds in auscultation. The Council on Physical Medicine and Rehabilitation voted to include the apparatus in its accepted list.

Cameron Cauteradio Model O-25. — Manufactured by Cameron Surgical Specialty Company, 666 W. Division St., Chicago 10, Ill., device is generator of currents for cutting and coagulating. Currents are tube-generated and apparatus is small enough to carry and can be set on a table. The Council on Physical Medicine and Rehabilita-

tion voted to include Model O-25 in its list of accepted devices.

Fischerquartz Lamp Model 32. — Manufactured by R. A. Fischer & Company, 517 Commercial St., Glendale 3, Cal., lamp is a source of ultraviolet radiation designed for orificial use. The Council on Physical Medicine and Rehabilitation does not believe that orificial application is rational in such conditions as hay fever, ozena, otitis media and sinus infections and accepted the device only with this understanding.

M. S. A. Pneolator. — Manufactured by Mine Safety Appliances Company, 201 N. Braddock Ave., Pittsburgh 8, Pa., device administers artificial respiration by means of intermittent positive pressure without suction. The Council on Physical Medicine and Rehabilitation voted to include the apparatus in its accepted list as an artificial breathing device for use in hospitals, operating rooms and other medical institutions under the direction of a physician.

Personals

At the October meeting of the Pennsylvania Academy of Physical Medicine and Rehabilitation, the following officers were elected: Dr. **Herman L. Rudolph,** President; Dr. **Frank L. Follweiler,** Vice-President; Dr. **J. Murl Johnston,** Treasurer, and Dr. **Charles A. Furey,** Secretary.

At the November meeting of the Academy, Dr. **Richard Smith** presented "Rehabilitation in Rheumatic Diseases."

At the Fall Conference of the Oklahoma City Clinical Society, Dr. **Winthrop M. Phelps,** presented the topic "Cerebral Palsy."

Dr. **Howard A. Rusk** has been appointed Chief Medical Consultant in the national program of civilian vocational rehabilitation by Mary E. Switzer, Director, Office of Vocational Rehabilitation.

The University of Buffalo, Buffalo, N. Y., has appointed seven individuals in the field of physical medicine and rehabilitation to serve as a "team" at the University's new Chronic Disease Research Institute. Primary attention will be given to research and the group will work on the problems of advancing the handicapped patient "from the bed to a place in industry." Dr. **Henry V. Morelewicz** will direct the work, since he is Chief of the Department of Physical Medicine and Rehabilitation.

Dr. **Albert A. Martucci** has been appointed chairman of the new Cerebral Palsy Center's medical and professional board. The new center is located in the Chestnut Hill section of Philadelphia.

On November 12, 1951, Dr. **Herman J. Bearzy,** Head of the Department of Physical Medicine and Rehabilitation of the Miami Valley Hospital, spoke to the Medical and Surgical Staff of the Good Samaritan Hospital in Dayton, Ohio, on "Occupational Therapy in a General Hospital."

Dr. **Jessie Wright,** President of the Pittsburgh Chapter of the American Rheumatism Association, had Dr. Philip Hench of the Mayo Clinic as guest speaker at the opening scientific meeting of the year. Dr. Hench discussed modifications in use of cortisone and corticotropin and outlined rational balance in all therapy including physical medicine. He was honored at noon of the same day by the Pittsburgh Chamber of Commerce as "Pennsylvania Week Ambassador." At this luncheon he gave an interesting and humorous account of his experiences on his trip to Sweden to receive the Nobel Prize.

Dr. **Arthur L. Watkins** has been elected to succeed Dr. Garrey on the Council on Physical Medicine and Rehabilitation of the American Medical Association.

Dr. **Frances Hellebrandt** of the Medical College of Virginia has been appointed professor and head of the Department of Physical Medicine and Rehabilitation at the University of Illinois College of Medicine. She will assume her new duties on December 1. The title of Chief of Physical Medicine and Rehabilitation at the University of Illinois Research and Education Hospitals has also been given her.

Dr. Hellebrandt is succeeding Dr. **H. Worley Kendell,** who has resigned to accept a position as Medical Director of the Institute of Physical Medicine Rehabilitation, Peoria, Illinois. Dr. Kendell will retain an appointment in the College of Medicine as Clinical Professor of Physical Medicine and Rehabilitation.

School for Palsied Children

A public school for cerebral palsied children has been opened in Clifton, New Jersey, where the children will receive both schooling and therapeutic training. Instruction is largely on an individual basis.

Examination for Medical Officers U. S. Public Health Service

A competitive examination for appointment of medical officers to the Regular Corps of the U. S. Public Health Service will be held on February 5, 6, and 7, 1952. Applications must be received no later than January 2, 1952.

Application forms and additional information may be obtained by writing to the Surgeon General, U. S. Public Health Service, Washington 25, D. C., attention of Division of Commissioned Officers.

Pamphlets on Rehabilitation

The National Society for Crippled Children and Adults Library has prepared a list of 451 pamphlets on rehabilitation. The collection covers all phases of rehabilitation on the care, welfare, education, and employment of the crippled and disabled. This package service is available to responsible persons and agencies without charge.

Newly Registered Therapists

October 29, 1951

Allen, Judith, 418 Hull Ct., Waukegan, Ill.

Anderson, Lorraine L., 2539 11th Ave., S., Minneapolis 4, Minn.

Archibald, Lois B., 1522 S. 7th St., Fargo, N. D.

Brydolf, Barbara, 1157 Sonoma Dr., Altadena, Cal.

Burns, Mildred, 850 DuBois Dr., Baton Rouge, La.

Causton, Phyllis L., Box 416, Grand Coulee, Wash.

Clas, Blanca E., Cementerio, Ciales, P. R.

Crow, Joanne, 2615 Windsor Ave., Chicago 25, Ill.

Delich, June G., 11022 S. Lowe Ave., Chicago 28, Ill.

Foster, Edna J., Box 64, Suttons Bay, Mich.

Geraci, Lois L., 343 First St., La Salle, Ill.

Halvorson, Frances L., Felton, Minn.

Hanson, Lillian B., 2728 Garfield Ave., S., Minneapolis 8, Minn.

Jensen, Robert H., 916 Dearborn St., Caldwell, Idaho.

Johnson, Richard J., 2500 Cleveland Ave., St. Joseph, Mich.

Kocialski, Adeline J., 701 Terrace Blvd., Depew, N. Y.

Kohlstrom, Mary Ann, 4126 Wolf Rd., Western Springs, Ill.

LeMaire, Gloria W., La Grange, Ill.

Ludwig, Shirley M., 1009 Court St., St. Joseph, Mich.

Lyle, Virginia L., 538 Palm Ave., South San Francisco, Cal.

MacDonald, Joseph N., 1900 Park Ave., Minneapolis, Minn.

McCartney, Margaret, 6137 S. Massasoit Ave., Chicago 38, Ill.

McKain, Jean M., 704 Washington St., Columbus, Ind.

Mester, Odetta N., 1036 Jackson, Quincy, Ill.

Monlux, John H., 2527 Baker, Everett, Wash.

Morley, Margaret A., 303 School St., Harbor Beach, Mich.

Myers, F. Pauline, 711 N. Adams St., Polo, Ill.

Pelusio, Blandine, 269 Carroll St., Paterson, N. J.

Ritz, Marilyn M., 2125 Culbertson Ave., New Albany, Ind.

Rumpler, Annemarie, 645 W. 160th St., New York 32, N. Y.

Stupka, Eleanor B., 894 Stambaugh Ave., Sharon, Pa.

Van Etten, Albert K., 1414 18th St., Hood River, Oreg.

Weiss, Barbara J., 172 S. Downing, Denver, Colo.

November 8, 1951

Anderson, Marilyn J., 2010 Blue Ridge Dr., Seattle 77, Wash.

Barnes, Joan A., 13 Juliette Rd., Saugus, Mass.

Grimm, Anne Marie, 929 E. 104 St., Brooklyn 36, N. Y.

Lambertson, Elizabeth L., New Durham, N. H

Nelson, Shirley Ann, Box 301, Metuchen, N. J.

Osborne, Elizabeth M., 2617 Pinecroft Rd., Greensboro, N. C.

Potter, Olive J., Box 276, Wheelwright, Ky.

Westhoven, Mary Frances, 230 Kolbe St., Napoleon, Ohio.

Winn, Patricia Ann, 2527 Densmore Dr., Toledo, Ohio.

November 28, 1951

Abrams, Kathryn E., 1044 W. Main St., Decatur, Ill.

Stempniak, Henry F., 2625 W. 21st St., Chicago 8, Ill.

Stuart, Herbert A., 1227 N. Mansfield Ave., Hollywood 38, Cal.

BOOK REVIEWS

ILLEGITIMATE SONNETS. By *Merrill Moore*. Cloth-bound. Price, $2.75. Pp. 125. Twayne Publishers, New York 4, 1950.

The contents of this book are profoundly poetic not merely in form but also in content. Deviating from the traditional sonnet in rhyme-scheme but not in meter, the author expresses now the bitterness, now the beauty, of life on both sides of the Pacific. His curiously detached yet delicate recording of the manifestations of human happiness, grief, contrariness, and futility reminds one of the Lindsay translations of Petronius, and makes one wonder whether this can be a sign of the times.

CLINICAL TROPICAL MEDICINE. By *R. B. H. Gradwohl*, M.D., Editor-in-Chief; *Luis Benitez Soto*, M.D., Editor; and *Oscar Felsenfeld*, M.D., Editor. Cloth-bound. Price, $22.50. Pp. 1647 with 473 illustrations and 6 color plates. The C. V. Mosby Company, St. Louis, Missouri, 1951.

Fifty-seven authorities from both hemispheres have contributed to this impressive volume, and much of the text is a translation from manuscripts submitted in foreign languages. Nevertheless, a remarkable unity and coherence is maintained, so that the net result is both practically useful and very readable.

Successive chapters take up diseases caused by protozoa, bacteria, viruses, yeasts, fungi, and larger animal parasites, venenation caused by various animals such as snakes, diseases related to diet, general problems of therapeutics and hygiene, and special laboratory techniques. The book has many helpful illustrations, specific diagnostic and therapeutic directions, and a representative, copious bibliography. It is a substantial, valuable addition to an important and inexhaustible subject.

HOW TO STOP KILLING YOURSELF. By *Peter J. Steincrohn*, M.D. Fellow of the American College of Physicians; Consultant in Internal Medicine to the Institute of Living of Hartford; visiting physician to McCook Memorial Hospital and Mount Sinai Hospital of Hartford. Paste Board Cover. Price, $2.95. Pp. 272. Wilfred Funk, Inc., 381 Fourth Avenue, New York 16, New York.

Elaborating the well-known psychiatric tenet that the urges for self-preservation and for self-destruction are both active in normal people, Steincrohn focuses upon the self-destructive urge. He reveals the surprisingly varied ways in which it affects our physical, mental, and social activities. Under his clever treatment, the recognition of a self-destructive habit for what it is automatically becomes a suggestion for hygiene. The book abounds in illuminating concepts, and will bring inspiration to innumerable readers, both physicians and patients.

PHYSICAL DIAGNOSIS. By *Raymond W. Brust*, A.B., M.D., F.A.C.P., Associate in Medicine, University of Pennsylvania Medical School. Introduction by *Truman C. Schnabel*, A.B., M.D., F.A.C.P. Cloth. Price, $4.50. Pp. 294 with illustrations. Appleton-Century-Crofts, Inc., 35 West 32nd Street, New York 1, 1951.

This small size edition textbook of physical diagnosis by Dr. Raymond W. Brust is especially prepared for use by medical students and interns. It meets the requirements exceedingly well as it is well written in a straightforward fashion, is easy to read and is planned sufficiently simply to allow for easy consumption and integration by all interested students. The book is divided into six parts, the first two being concerned with the principles of physical diagnosis and the body in general. The last four parts concern more specifically the pulmonary, cardiovascular, gastrointestinal and nervous systems of the body. Illustrations and photographs are plentiful and add considerably to the presentation of the material as well as the understanding of same. The emphasis on the art of physical diagnosis and its importance as it concerns the student of medicine cannot be questioned. The publishing is well done and the book is recommended to all medical students and interns.

STATISTICS FOR MEDICAL STUDENTS AND INVESTIGATORS IN THE CLINICAL AND BIOLOGICAL SCIENCES. By *Frederick J. Moore*, M.D., Associate Professor of Experimental Medicine, University of Southern California School of Medicine; *Frank B. Cramer*, B.A., Research Fellow, and *Robert G. Knowles*, M.S., Research Associate, Department of Experimental Medicine, University of Southern California School of Medicine. Fabrikoid. Price, $3.25. Pp. 113 with 17 figures and 16 tables. New York, Philadelphia and Toronto. The Blakiston Company, 1951.

This text is an introduction to the study of statistics for students and investigators in medicine and its basic sciences. The principal concern of the authors has been to provide a grasp of the most fundamental concepts and philosophies rather than to develop technical facility in the application of statistical methods. Every science has to develop its own vocabulary and the authors

have made an effort to define new usage and extension of the meaning of old words.

Most of the techniques and concepts presented by the writers require no more mathematics than is generally required for admission to a medical school or a candidature for an advanced degree For those workers who have had sufficient mathematics this presentation would be somewhat unsatisfactory.

Five chapters are presented: one, variation and the normal curve of error; two, fitting the normal curve of error to the data; three, sampling and distributions and tests of significance; four, the problem of non-normal distributions; and five, general aspects of the design of experiments and presentation of results. Each chapter is adequately subdivided and is concluded with an excellent summary of the subject matter. A small but excellent list of references is included for those who wish to undertake a more intensive study. There is also an appendix giving a summary and page index of methods for numerical calculations, an appendix giving calculations of normal equivalent deviates, and an appendix consisting of eight numerical tables.

The text is well written and the material for study ably presented. A great deal of the research work presented in physical medicine today requires an understanding of the statistical methods presented in this excellent volume. This book is highly recommended to all physiatrists and research workers in the field of physical medicine.

GOOD HEALTH FOR YOU AND YOUR FAMILY. By *E. Patricia Hagman*, Ed.D., Editor, Associate Professor of Health and Physical Education, Teachers College, Columbia University. Pp. 304 with 20 illustrations. A. S. Barnes & Company, 101 Fifth Avenue, New York 3, New York.

This book justifies the expectations raised by its attractive dust cover, for the contents merit attentive reading. Based on the immense experience of an outstanding insurance company, it makes positive suggestions on almost every imaginable question that might arise concerning health and physical efficiency. The four principal divisions are headed "Hints for Good Health," "Common Diseases and Disorders," "Child Care," and "Safety and First Aid." The authors have tried to waste no words, to eliminate the negative and to tell people what to do rather than what to think. The effect of this resolute accentuation of the positive in modern literature is sometimes a bit odd, like an overdose of optimistic wholesomeness flavored with a curious dogmatism; at times it results in actual omissions, as in the allusion to two types of unconsciousness in diabetics, without further explanation, on page 290. In their discussion of posture the authors seem bent on finding scientific justification for esthetic prejudices, for the distinction between relaxing and slumping is not clear, and emphasis is more on the unattractive appearance of some relaxed types of posture than on the bad circulatory effects of enforced standing, abnormal erectness, and prolonged immobility.

The passage concerning athlete's foot needs revision in the light of recent publications by Jordon and by Gaul and Underwood. These minor faults detract little from the total value of this excellent book, which can be recommended heartily as a sound and amazingly comprehensive guide for reference in home and school.

A TEXTBOOK OF PATHOLOGY. Second Edition. PATHOLOGIC ANATOMY IN RELATION TO THE CAUSES, PATHOGENESIS, AND CLINICAL MANIFESTATIONS OF DISEASE. By *Robert Allan Moore*, and *Edward Mallinckrodt*, Professor of Pathology, Washington University School of Medicine, St. Louis. Cloth. Price, $12.00. Pp. 1048 with illustrations. W. B. Saunders Company, W. Washington Square, Philadelphia 5, 1951.

This second edition of an already well received textbook of pathology is a well written and comprehensive work on both general and special pathology. Improvements are noted in the form of additions, and particularly of interest are the newly added chapters on "Disturbances in the Metabolism of Enzymes," "General Considerations of the Infectious Diseases," and "Diseases Peculiar to the Aged." Once again the references to the material presented are most adequate and should yield any desired additional information with ease. The text is well illustrated with many and varied photographs which correlate the pathology with the clinical observations presented. The material has been rearranged in part and there is an adequate index. The publishing is good and the book should prove useful to all medical students and physicians.

PHYSICAL MEDICINE ABSTRACTS

Effect of Transportation on Severity of Acute Poliomyelitis. M. Bernard Brahyd, and Selig H. Katz.

J. A. M. A. **146**:772 (June 30) 1951.

Fatality rates are recorded for a group of patients with poliomyelitis who were transported to the hospital over long distances and for a comparable group of patients who were transported short distances. In the same groups the deaths which occurred within 24 hours after admission to the hospital are recorded. All patients with poliomyelitis admitted to the Willard Parker Hospital between June 13 and October 31, 1949, are included. The results indicate that transportation of patients over long distances may be harmful in the acute stage of the disease.

The Problem of the Common Case of Low Back Pain. John McM. Mennell.

Stanford M. Bull. **9**:88 (May) 1951.

Following an operation for disc enucleation, it is the reeducation of the patient (or, too frequently, the lack of it), rather than the extent of the surgery, which determines the success or failures of the procedure. Different surgeons allow the patient out of bed at varying times: whenever that time is, the importance of having the patient wear his walking shoes cannot be too highly stressed. From the moment the patient gets up, he should be taught to walk, and not allowed to shuffle, for a shuffling gait also is detrimental to posture. When the patient is ready for ambulation, gentle, assisted erector spinae muscle contractions may be carried out in bed, within the limits of pain; graduated faradic treatment to the muscles damaged by operation will shorten their recovery period. When the patient is ready to leave the hospital, he should spend the next three to four weeks in a convalescent institution where plunge-bath facilities are available. The water should be warm or hot, and of high specific gravity. During the first week of convalescent treatment, ten minutes graduated back-extension exercise in a plunge bath, four times a day, followed by half an hour to one hour of bed rest, is the routine which Mennell has his patients follow. Then once a day, for a half hour or more, they have physical therapy as required, and this may include anodal galvanism to a residually tender sciatic nerve, faradism to the damaged back muscles, skin-rolling for any associated panniculitis, histamine ionization to any especially resistant tender area, and, to finish, effluvage to the back for relaxation. The patient should do no walking except to and from treatments, meals, and the bathroom. When sitting in a chair, the patient is taught to keep his buttocks against the back of the seat, and to sit up. If this tires him, he must lie down. The patient is forbidden to stoop or to lift, and is taught to pick things up from the floor by squatting. In the second week of convalescent treatment, the patient starts going for walks of no more than a quarter-mile, the distance being increased every few days. The only other change during this week is that during his physical therapy session, he starts assisted back-extension exercises in the treatment room. In the third week, in addition to the above, the patient does unassisted back-extension exercises on rising and retiring, and starts lifting, using his legs and not his back; stooping from the hips is a habit of laziness, which must be broken. At the end of the third week of this regime (which usually means six weeks postoperatively), the patient is returned to his home, and may go back to work a week later. If his work is heavy, he should be, ideally, allowed light duties for the next three months, during which his work should be graduated and supervised. An intelligent patient, however, is usually able to graduate his own work satisfactorily. Stooping, twisting, and lifting with the back are absolutely contraindicated, and back-extension exercises night and morning must be continued indefinitely.

The common practice of keeping patients in the hospital without physical therapy for three weeks following disc surgery, then sending them home for a week or two of unsupervised "rest" before returning to their normal activities entirely defeats the original purpose of the surgery. Unless a consistent and intelligent effort is made to re-educate these patients, there must always be a grave risk that they may become additions to the all-to-numerous group of operative failures.

Fractures About the Ankle. Rex L. Diveley.

J. Missouri M. A. **48**:437 (June) 1951.

Diveley's routine in fractures about the ankle is to reduce them at the earliest possible moment and immobilize in a plaster cast. Early weight bearing is highly satisfactory provided firm immobilization of the fragments can be maintained. At the end of two weeks, a heel piece or walking iron may be incorporated in the cast, and weight bearing insisted upon. The after-treatment or period of rehabilitation is most important in ankle fractures. At the end of from six to eight weeks, depending upon the severity of the fracture, the cast is bivalved and physical therapy in the form of massage, passive and active exercises with whirlpool is given. In ten days or two weeks, if the x-ray examination shows an adequate union of the fragments, the cast may be discarded and

the foot fitted in a strong supporting shoe. Any existing foot imbalance must be corrected by supports and shoe alterations or both.

Iontophoresis in Ophthalmology. Vernon L. Smith.

Am. J. Ophth. 34:698 (May) 1951.

The treatment of ocular disease by iontophoresis has assumed increasing importance with the advent of chemotherapy and the antibiotics. Ion transfer of these drugs often serves to introduce them into the globe in concentrations greater than can be obtained by any other method short of actual inoculation. The purpose of this paper is to review briefly the literature on the theory, technique and clinical applications of ocular iontophoresis. The use of iontophoresis for the introduction of certain drugs into the eye is based upon sound scientific principles. The selection of the charge to be used at the active electrode varies with the drug employed. This charge must be the same as that of the ion which is to be introduced into the eye. The apparatus required for ocular iontophoresis is both simple and inexpensive. The technique of iontophoresis is easily carried out in the busy office or hospital in but a few minutes. Ion transfer provides a method of introducing high concentrations of many useful drugs into the eye.

Senescence inevitably brings with it various ailments and disabilities, one of the commonest of which is some form of arthritis or rheumatism. These forms are discussed as to their effect on the aging patient. Physical therapy is recommended as an adjunct in the treatment of these conditions.

Rheumatoid Spondylitis. Le Moyne Copeland Kelly.

Connecticut M. J. 15:672 (Aug.) 1951.

In the treatment of rheumatoid spondylitis every patient should receive a high vitamin, high caloric diet, regulated rest, salicylates for pain and daily home physical therapy measures. Prevention of postural deformity is imperative and every effort should be expended towards this end. A great deal can be accomplished by relatively simple home measures, if the patient will carry them out conscientiously each day over a period of years. He should be taught to assume the proper posture as much as possible — with the lower abdominal muscles pulled in, the thorax raised, the shoulders squared and the head erect. In addition, he should be instructed in trunk-stretching exercises, hamstring and calf-stretching exercises, in deep breathing exercises and in special exercises for the correction of any marked postural defects. These should be performed twice daily at home. Analgesics taken an hour beforehand and followed by the application of heat often will permit the patient to carry out this program more enthusiastically. The patient should be apprised of the necessity for a firm bed without pillows and instructed in the use of the blanket roll beneath the thoracic area to effect hyperextension of the spine. In this way it is possible to keep the trunk in proper alignment, and to prevent deformities while the patient is receiving more specific therapy for his disease. Rheumatoid spondylitis is not invariably a chronic, progressive, disabling disease of the spinal column for which nothing can be done. Although it is often self-limited, in order to contribute to the patient's comfort and to prevent possible deformity in the event of progressive involvement, it is imperative that the diagnosis be made early and that appropriate general measures and x-ray therapy be instituted at the first opportunity.

Dupuytren's Contracture: A Clinical Review. James A. Ross, and J. Hunter Annan.

Ann. Surg. 134:186 (Aug.) 1951.

A series of cases of Dupuytren's contracture are reviewed, and the anatomy of the fascia of the hand is briefly described. The etiology of Dupuytren's contracture is discussed, and pathologic and clinical features are described. The tendency of Dupuytren's contracture to develop on the ulnar side of the hand involving especially the fourth and fifth fingers; the bilateral nature of the condition; the tendency to progress at a varying rate; and the frequency of dorsal knuckle pads, are noted. Treatment is described. A combination of operation and vitamin E has recently been adopted. The operation consists of meticulous dissection of the palmar fascia plus its prolongations. Postoperatively, 16 patients had plaster of paris splints applied for 10 to 21 days; the remainder had no splint applied. Active exercises under trained supervision were instituted following removal of the stitches. The response, in the extent of benefit, at this stage depended largely on the patient's intelligence quotient. Some mention is made of certain postoperative complications which occurred.

Painful Shoulders: Periarthritis. Hugh Smith.

J. Tennessee M. A. 44:330 (Aug.) 1951.

Periarthritis — a general term loosely applied to a substantial group of closely related conditions — may severely cripple a shoulder and cause a lot of misery. The tendency toward spontaneous recovery does not detract from the necessity of adequate and prompt treatment. Pain and disability are frequently severe and may last for days, weeks or months. Though response to therapy frequently is slow, most of these patients get relief from pain and a functional shoulder; a few retain a painful stiff joint; some are cured. For the relief of pain the following measures are available; Novocaine injections, roentgen-therapy and cortisone; if calcium deposits are present, needling and aspiration, or surgical incision and curettage. Splinting of the shoulder in a functional position is an adjunct to the above measures, but should be used only during the most acute phase of the

disease. For restoration of motion and function we must rely principally upon physical therapy in the form of heat, massage, and active and passive stretching exercises, rarely manipulation. Obviously it is not necessary or desirable to apply all of these measures simultaneously. The stage of the disease and the facilities that are available must to a degree determine the most desirable combination. A summary of therapy reveals that physical therapy is the only form of treatment that is common to all stages and types of periarthritis. Consequently it assumes importance. An extensive array of equipment is not necessary and, though very desirable, a trained physical therapist is not indispensable except for the more complicated cases. However, someone must assume the responsibility for teaching these patients how to bake and massage their shoulders, and impress them with this fact, baking and massage will not restore motion, rather it must be exercises performed many, many times. Codman exercises are simple and effective. With two or three pounds suspended from the wrist, and the spine flexed, the shoulder joint — not the shoulder girdle — can be exercised by side to side, forward and backward, and circumduction movements without fighting the forces of gravity. Simple pulley arrangements and wall ladders can be rigged up at home to supplement the Codman exercises. For the chronically affected shoulders, a home physical therapy set-up is mandatory since response will be slow, and few people can afford prolonged hospitalization or the services of a physical therapist until they are well. When treatment is rather non-specific as in periarthritis, attention to small details is important. The results come slowly most of the time, but 80 per cent of these patients will recover if the physician and the patient do not get impatient.

Treatment of Lame Backs. Frank R. Ober.

Postgrad. Med. **10**:146 (Aug.) 1951.

Many patients with lame backs are treated by the family physician and most of them recover under his care. Sedatives are given to relieve not only pain but also spasm of the back muscles. The bed should be firm and flat, using a bed board if necessary. Application of heat by means of hot packs, electric pad (low heat) or a heat lamp is soothing and helps to relieve pain and muscle spasm. Prolonged heat increases congestion and often causes more discomfort. Generally speaking, heat should be applied for approximately 15 minutes and repeated at four hour intervals. The back can be protected more or less by a 10 inch wide Ace or similar bandage or by a scultetus binder. In the less severe types of backache which are sudden and not too incapacitating, adhesive plaster strapping often is helpful. In prolonged cases of backache a well fitting corset is the most useful of all supports if it is properly constructed. Steel braces will fit when the patient stands, but not when he sits, often digging into the lumbar muscles and causing spasm. The problem in the lame back is to secure relief of pain and muscle spasm and to restore the physiologic curves of the spine. The ambulatory lame back patient must be given advice about stooping, lifting and twisting. Any of these movements will increase the symptoms and, if the patient is symptom-free, may cause a recurrence, especially if nothing has been done to restore the patient's musculature after he has recovered from an attack. The first rule in treating any joint is to impress upon the patient the fact that any act which causes pain is bad. The proper way to lift an object is to do so with the knees flexed, preventing the posterior thigh and leg structures from pulling on the low back. Individuals who have short posterior leg, buttock and thigh muscles and fasciae are restricted in forward bending so that there is increased leverage on the lumbosacral and sacro-iliac regions. This fact makes these persons more susceptible to backache. After the pain and muscle spasm have subsided, the muscles which support the back must be restored by special exercises. Contracted fasciae and muscles should be stretched out, and, after these two things have been accomplished, exercises to correct bad posture are prescribed. One exercise which is frequently prescribed is forward bending of the trunk when the legs are straight. This exercise should not be done as it may cause a recurrence of the difficulty. Where there has been interference with joint function there has been, as a result, a disturbance of the muscles controlling that joint. Therefore, exercises must be prescribed which will restore these muscles to a normal function or there will be recurrence of joint disability. A great many patients have lame backs from a short leg or from inequalities in the pelvis which produce a functional curve of the spine. The spine is made plumb by blocking up the heel of the shoe on the side of the convexity of the curve until it is straight. If the calf muscles are short on passive dorsal flexion of the foot with the knee extended, the heels of the shoes should be raised enough to compensate for such shortening. In many instances of moderate sciatic pain, raising the heel on the opposite side will give relief, sometimes in a few days. The stretching and muscle exercises should be continued for several weeks or until all the shortened structures are stretched, the muscles restored to normal and the bad posture has been corrected.

ARCHIVES *of* PHYSICAL MEDICINE

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OFFICERS OF THE AMERICAN CONGRESS OF PHYSICAL MEDICINE

EXECUTIVE AND EDITORIAL OFFICES
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SUBJECT INDEX

This is an index to all the reading matter in the ARCHIVES, except the Medical News Department.

The letters used to explain in which department the matter indexed appears are as follows: "E," Editorial; "C," Correspondence; "ab," abstracts; the asterisk (*) indicates an original article in the ARCHIVES.

This is a subject index and one should, therefore, look for the subject word, with the following exceptions: "Book Reviews" and "Deaths," are indexed under these titles at the end of the letters "B" and "D." The name of the author, in brackets, follows the subject entry. If there are more than two authors, only the name of the first author is given.

For author index see page 807.

BOOK REVIEWS

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AUTHOR INDEX

In this Index are the names of the authors which have appeared in the *Archives*. The asterisk (*) preceding the page reference indicates that the article appeared in full in the *Archives*, "d" refers to discussion and "c" correspondence. The "ab" following page references indicates abstract. For subject index see page 798.

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APPROVED SCHOOLS OF PHYSICAL THERAPY **

Council on Medical Education and Hospitals of the American Medical Association

Name and Location of School	Medical Director and Technical Director	Entrance Requirements[1]	Duration of Course	Classes Begin	Maximum Enrolment	Tuition	Certificate, Diploma, Degree
Medical Department — U. S. Army							
(Address all inquiries to the Office of the Surgeon General, Department of the Army, Washington 25, D. C.)							
Medical Field Service School, Brooke Army Medical Center, Fort Sam Houston (San Antonio), Texas	J. E. Tate, Lt. Col., M.C. Agnes P. Snyder, Maj., WMSC	b-e	44 wks.	Oct	20	None	Certificate
Fitzsimons Army Hospital, Denver	H. B. Luscombe, Col., M.C. Olena M. Cole, Maj., WMSC	Affiliated with Medical Field Service School					
Letterman Army Hospital, San Francisco, California	A. E. White, Col. M.C. Emma Harr, Maj., WMSC	Affiliated with the Medical Field Service School					
Walter Reed Army Hospital, Washington, D. C.	J. H. Kuitert, Lt. Col., M.C. Brunetta Kuehlthau, Maj., WMSC	Affiliated with Medical Field Service School					
Nonfederal							
Childrens Hospital, Los Angeles*	S. S. Matthews, M.D. Mrs. Mary J. Dodge	a-b-d	14 mos.	Sept	14	$300	Cert. or Degree
College of Medical Evangelists, Los Angeles*	F. B. Moor, M.D. R. Wm. Berdan	a-b-c	15 mos.	Sept	16	$300	Cert. or Degree
University of Southern California, Los Angeles*	C. L. Lowman, M.D.	a-b-d	14 mos.	Sept	16	Univer.	Certificate
University of California School of Medicine, San Francisco*	Charlotte W. Anderson Lucile Eining, M.D.	f d	4 yrs. 12 mos.	FebSept Sept	6 16	Univer. $220[2]	Cert. & Degree Cert. or Degree
Stanford University, Stanford University, Calif.*	Margery L. Wagner W. H. Northway, M.D.	a-d-e	12 mos.	Varies	29	$690	Certificate
University of Colorado Medical Center, Denver*	Lucille Daniels Harold Dinken, M.D.	f a-b-d	4 yrs. 12 mos.	Sept Sept	16 12	$220 qr. $208[2]	Degree Cert. or Degree
Northwestern University Medical School, Chicago	Mary Lawrence E. D. W. Hauser, M.D.	a-b-d	12 mos.	Oct	16	$450	Certificate
State University of Iowa College of Medicine, Iowa City*	Gertrude Beard W. D. Paul, M.D.	e	12 mos.	Sept	20	$200	Certificate
University of Kansas Medical Center, Kansas City, Kan.*	Olive C. Farr D. L. Rose, M.D.	d	12 mos.	FebSept	3	$40[2]	Certificate
Simmons College, Boston	Ruth G. Monteith W. T. Green, M.D.	f a-e	4 yrs. 16 mos.	FebSept Sept	9 24	$40[2] College	Degree Diploma
Boston University College of Physical Education for Women, Sargent College, Cambridge, Mass.	Shirley M. Cogland Kenneth Christophe, M.D.	f c-d-e-f	4½ yrs. 1-2-4 yrs.	Sept Sept	30	Univer.	Degree Cert. or Degree
Bouve-Boston School of Physical Education, Medford, Mass.	Adelaide L. McGarrett Howard Moore, M.D.	f	4 yrs.	Sept	16	$550	Dipl. & Degree
University of Minnesota, Minneapolis*	Constance K. Greene F. J. Kottke, M.D.	c	2 yrs.	Sept	20	$126	Degree
Mayo Clinic, Rochester, Minn.*	Ruby Green Overmann E. C. Elkins, M.D.	a-b-c	2 yrs.	Sept	38	$250	Certificate
St. Louis University, Division of Health and Hospital Services, St. Louis*	Harry Keown A. J. Kotkis, M.D.	f	4 yrs.	JanSept	12	$175 Semes.	Degree
Washington University School of Medicine, St. Louis*	Sister Mary Imelda Sedgwick Mead, M.D.	c	2 yrs.	Sept	16	$450 1st yr. $325 2d yr.	Degree
Albany Hospital, Albany, N. Y.	Beatrice F. Schulz J. W. Ghormley, M.D.	a-b-d	12 mos.	Sept	6	$300	Certificate
Columbia University College of Physicians and Surgeons, New York City*	Catharine Graham W. B. Snow, M.D.	f a-c-e	4 yrs. 1-2 yrs.	Sept Sept	50	$500 $680 (1 yr.) $1,200 (2 yrs.)	Degree Cert. or Degree
New York University School of Education, New York City*	Floy L. Pinkerton G. G. Deaver, M.D.	a (+1 yr. coll.) b-d	12 mos.	Sept	40	$615	Cert. & Degree
Duke University, Durham, N. C.*	Elizabeth C. Addoms L. D. Baker, M.D.	a-b-d	15 mos.	Oct	12	$350	Certificate
Cleveland Clinic Hospital, Cleveland*	Helen Kaiser Walter J. Zeiter, M.D.	a-b-c	12 mos.	Oct	12	$200	Diploma
D. T. Watson School of Physical Therapy, Leetsdale, Pa.*	Mildred Heap Jessie Wright, M.D.	a-b-d	12 mos.	Oct	25	$300	Diploma
Division of Physical Therapy of the School of Auxiliary Medical Services of the University of Pennsylvania, Philadelphia*	Kathryn Kelley G. M. Piersol, M.D.	e	12 mos.	FebSept	32	$600	Certificate
University of Texas School of Medicine, Galveston*	Dorothy E. Baethke	f	4 yrs.	Sept	40	$600	Cert. & Degree
Hermann Hospital, Houston, Texas*	G. W. N. Eggers, M.D. Ruby Decker	a-b-d	12 mos.	Jan	8	$149[2]	Cert. or Degree
Baruch Center of Physical Medicine and Rehabilitation, Medical College of Virginia, Richmond*	O. O. Selke, Jr., M.D. Mary Elizabeth Kolb	a-b-d	12 mos.	Oct	15	$300	Certificate
University of Wisconsin Medical School, Madison*	W. J. Lee, M.D. Susanne Hirt	a-b-d f	12 mos. 4 yrs.	Sept Sept	52	$300[2]	Diploma Degree
	H. D. Bouman, M.D. Margaret A. Kohli	a-b-d	12 mos. 4 yrs.	Sept FebSept	22 20	$60 Semes.[2]	Certificate Cert. & Degree

** Reprinted in part J. A. M. A. 146:197 (May 12) 1951.

1. Courses are so arranged that any of the entrance requirements will qualify students for training. a = Graduation from accredited school of nursing; b = Graduation from accredited school of physical education; c = Two years of college with science courses; d = Three years of college with science courses; e = Four years of college with science courses; f = High school graduation.

2. Nonresidents charged additional fee.

* Male as well as female students admitted.

PHYSICAL MEDICINE AND REHABILITATION **

The following services are approved by the Council and the American Board of Physical Medicine and Rehabilitation. Residencies in this specialty have been approved without specifying the number of years for which they are accredited. The Board will give appropriate credit for training in these hospitals on an individual basis.

Hospitals, 43 Assistant Residencies and Residencies, 87

Name of Hospital	Location	Chief of Service	Inpatients Treated	Number of Treatments	First Year Residencies Offered*	Total Residencies Offered*	Beginning Stipend (Month)
UNITED STATES ARMY							
Letterman Army Hospital★	San Francisco	A. E. White	3,330	74,961	....	....	.....
Fitzsimons Army Hospital★	Denver	H. B. Luscombe	19,403	258,913	1	4	.....
Army Medical Center★	Washington, D. C.	J. H. Kuttert	6,755	263,456	3	5	.....
VETERANS ADMINISTRATION							
Veterans Admin. Hospital★[1]	Long Beach, Calif.	R. N. Nyquist	10,922	195,816	1	2	.....
†Veterans Admin. Hospital[1]	Fort Logan, Colo.	F. J. Fricke	907	36,326	....	....	.....
Veterans Admin. Hospital	Hines, Ill.	L. B. Newman	5,665	450,711	....	....	.....
Veterans Admin. Hospital[1]	Wadsworth, Kans.	L. Blau	3,159	192,760	....	....	.....
Veterans Admin. Hospital[1]	Framingham, Mass.	F. Friedland	7,000	210,000	1	3	.....
Veterans Admin. Hospital[1]	Jefferson Bks., Mo.	E. H. Weissenb'g	2,215	77,491	1	1	.....
Veterans Admin. Hospital[1]	New York City	A. S. Abramson	12,819	314,026	3	9	.....
Veterans Admin. Hospital[1]	Cleveland	H. T. Zankel	6,414	81,929	1	1	.....
†Veterans Admin. Hospital	Portland, Ore.	E. W. Fowlks	4,954	116,420	1	1	.....
†Veterans Admin. Hospital[1]	Aspinwall, Pa.	S. Machover	2,516	106,131	....	1	.....
Veterans Admin. Hospital★[1]	Houston, Tex.	B. L. Boynton	1,582	6,894	1	1	.....
NONFEDERAL							
Los Angeles County Hospital★[1]	Los Angeles	E. Austin	.....	91,836	....	1	165
White Memorial Hospital★	Los Angeles	F. B. Moor	195	.....	1	1	120
University of Colorado Medical Center Colorado General Hospital★[1]	Denver	H. L. Dinken	2,580	45,876	1	3	75
State of Connecticut Vet. Home & Hosp.	Rocky Hill, Conn.		.....	.....	3	3	.....
Emory University Hospital★	Emory Univ., Ga.	R. L. Bennett	1,719	10,473	1	1	50
Georgia Warm Springs Foundation	Warm Springs, Ga.	R. L. Bennett	973	104,401	1	3	250
Cook County Hospital★[1]	Chicago	D. Kobak	7,501	37,516	....	....	.....
Michael Reese Hospital★[1]	Chicago	C. O. Molander	2,254	19,589	1	1	25
Northwestern University Medical Center	Chicago		13,590	40,962	....	....	.....
Research and Educational Hospitals★[1]	Chicago	H. W. Kendell	5,688	11,769	1	3	55
University of Kansas Medical Center★[1]	Kansas City, Kans.	D. L. Rose	2,456	42,310	1	1	100
Massachusetts General Hospital★	Boston	A. L. Watkins	2,925	31,999	0	9	41.66
University Hospital★	Ann Arbor, Mich.		.....	.....	....	....	.....
University of Minnesota Hospital★[1]	Minneapolis	M. Knapp	20,409	29,436	4	4	.....
Mayo Foundation	Rochester, Minn.	F. H. Krusen	.....	.....	2	6	135
Barnes Hospital★	St. Louis	S. Mead	9,759	9,759	0	1	.....
†Bellevue Hosp., Div. III, N. Y. Univ.★[1]	New York City	H. A. Rusk	4,058	116,705	....	7	80
Goldwater Memorial Hospital★	New York City	M. Dacso	733	50,706	1	2	80
Hospital for Joint Diseases★[1]	New York City	J. Weiss	.....	94,631	1	1	40
Hospital for Special Surgery	New York City	K. G. Hansson	20,806	40,810	1	1	160
Mount Sinai Hospital★[1]	New York City	W. Bierman	11,942	36,970	1	1	50
New York City Hospital★[1]	New York City	F. K. Safford, Jr.	1,138	41,088	1	1	130
†Presbyterian Hospital★[1]	New York City	W. B. Snow	35,865	103,546	1	1	208
St. Luke's Hospital★[1]	New York City	R. Muller	900	98,954	1	1	60
†Rehabilitation Hospital	W. Haverstraw, N. Y.	M. Hoberman	5,868	408,371	1	1	225
Cleveland Clinic Hospital[1]	Cleveland	S. G. Gamble	17,062	38,475	1	4	.....
Hospital of the University of Pa.★[1]	Philadelphia	G. M. Piersol	1,636	35,639	0	1	.....
Philadelphia General Hospital★[1]	Philadelphia	A. A. Martucci	2,827	23,733	1	1	75
Medical College of Virginia—Hosp. Div.★[1]	Richmond, Va.	W. J. Lee	4,875	40,327	....	....	46.50

The star (★) indicates hospital approved for intern training.
The dagger (†) indicates temporary approval.
[1] Residencies open to women.
** Reprinted in part J. A. M. A. 147:440 (September 29) 1951.

Chicago Society of Physical Medicine and Rehabilitation

The regular January, 1952, monthly meeting of the Chicago Society of Physical Medicine and Rehabilitation will be held Wednesday, January 23, 1952, at the University of Illinois, 1819 W. Polk Street, Chicago, 8:00 P. M. "Peripheral Nerve Injuries" is the topic to be presented by Max K. Newman, M.D. of Detroit, Michigan. Preceding the scientific program, dinner will be served at the Medical Center, Y. M. C. A., 1804 W. Congress Street. Reservations should be made early with the Secretary of the Society, Dr. Milton G. Schmitt, 6970 N. Clark Street, Chicago 26.

Season's Greetings to Our Readers and Advertisers

MEETINGS OF INTEREST TO THOSE IN THE FIELD OF PHYSICAL MEDICINE AND REHABILITATION

In this column will be published information about meetings of interest to those in the field of physical medicine New data should be sent promptly to the office of the ARCHIVES, 30 North Michigan Avenue, Chicago 2, Illinois.

The National Society for Crippled Children and Adults, Inc. — 1952 annual convention, Fairmont Hotel, San Francisco, October 25, 26, 27, 28, 29 and 30, 1952. Lawrence J. Linck, Executive Director, 11 South La Salle Street, Chicago 3.

Chicago Society of Physical Medicine and Rehabilitation. — Meetings, fourth Wedesnday, January through May, 1952. Milton G. Schmitt, M.D., Secretary, 6970 N. Clark Street, Chicago 26.

International

International Congress of Physical Medicine (1952). London, July 14 to 19, 1952. Applications for the provisional program should be addressed to the Honorary Secretary, Dr. A. C. Boyle, International Congress of Physical Medicine (1952) 45, Lincoln's Inn Fields, London, W.C. 2.

American Society of Physical Medicine and Rehabilitation
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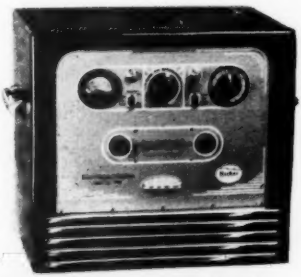

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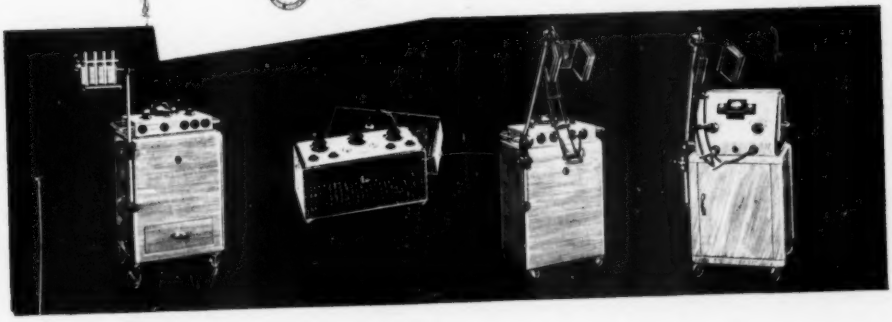

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